

**PHASE II ENVIRONMENTAL SITE ASSESSMENT
SITE-SPECIFIC
Sampling and Analysis Plan**

March 2003

**MCIDC PLAZA
MIFFLIN COUNTY INDUSTRIAL
DEVELOPMENT CORPORATION
Granville Township, PA**

**CORKINS PROPERTY
Lewistown, PA**

**RECREATION SITE
Granville Township, PA**

Prepared for

**Mifflin County
Department of Planning and Development
and
U. S. Environmental Protection Agency, Region III**

Prepared by

**ARM Group Inc.
Hershey, Pennsylvania**

Title and Approval Page

Sampling and Analysis Plan for:

MCIDC Plaza

Corkins Property

Recreation Site

Prepared by : Damian M. Zampogna – ARM Group Inc.

1129 West Governor Road, PO Box 797, Hershey, PA 17033-0797
(717) 533 - 8600

02/11/03

Cooperative Agreement Recipient: _____
Signature

Printed Name/Date

Project QA Officer: *Rhonda Hakundy-Jones* 3-20-03
Signature
Rhonda Hakundy-Jones March, 2003

TABLE OF CONTENTS

A. PROJECT MANAGEMENT

- A1 Site Information/Background
 - A1a MCIDC Plaza
 - A1b Corkins Property
 - A1c Recreation Site
- A2 Project Design
 - A2a MCIDC Plaza
 - A2b Corkins Property
 - A2c Recreation Site
- A3 Project Time Line
- A4 Measurement Quality Objectives

B. MEASUREMENT/DATA ACQUISITION

- B1 Sample Design
 - B1a MCIDC Plaza
 - B1b Corkins Property
 - B1c Recreation Site
- B2 Sampling Methods Requirements
- B3 Analytical Methods Requirements
- B4 Data Management
 - 1.0 Sample Documentation
 - 1.1 Field Logbook
 - 1.3 Standard Operating Procedures
 - 1.4 Field Data Records
 - 1.5 Analytical Data Deliverable Requirements
- B5 Sample Handling and Custody Requirements

C. DATA VALIDATION AND USABILITY

- C1 Review of Field Data
- C2 Data Validation
- C3 Reconciliation with User Requirements

APPENDICES

- Appendix A: ARM Standard Operating Procedures
- Appendix B: GLA Laboratory Qualifications Package
- Appendix C: EDQ Data Validation Qualification Package
- Appendix D: PADEP ACT 2 Action Limits
- Appendix E: Site-Specific Health and Safety Plan

A. PROJECT MANAGEMENT

A1 SITE INFORMATION/BACKGROUND

A1a MCIDC Plaza

The site is located at the MCIDC Plaza, 6395 SR 103 N, Granville Township, Mifflin County, Pennsylvania (Figure 1). The project site is situated in the western portion of the MCIDC Plaza property and consists of several former industrial buildings encompassing roughly nine (9) acres of the Plaza's 61-acre primary property. The site resides in a commercial/residential area along the south shore of the Juniata River, across from the Borough of Lewistown.

The majority of the buildings are brick or concrete structures that date back to the 1920s. The buildings housed a variety of operations ranging from light industrial to power supply. A detailed building history was included as part of the previously submitted Phase I ESA dated December 2000. The site currently serves as a multi-tenant industrial plaza, with the majority of the buildings being occupied except for the project area.

The findings of the December 2000 Phase I ESA determined that environmental conditions on the site warranted further investigation. The site has been broken into discrete areas of concern based upon the particular findings in the building areas, modified as appropriate to reflect current conditions.

Building 3

Several labeled and unlabeled and corroded drums were identified through the building, the labeled drums are suspected to contain polychlorinated bipheyl (PCB) -containing oils. Some of the corroded drums may have leaked on the concrete floor in the building. Four transformer pots were located and may be possibly filled with PCB-containing dielectric fluids. Former acid distribution lines were identified and are in a deteriorated state. Lead paint and asbestos-containing materials are suspected to be located within the building.

Building 7/Subsidence Basin

Accumulated water and sediment was identified at this location and suspected to potentially contain hazardous contaminants from the water treatment activities. Lead paint and asbestos-containing materials are suspected to be located within the building. This basin is reported to be concrete lined.

Building 33

A 500-gallon AST, which was identified in the basement, may contain potential hazardous materials. Lead paint and asbestos-containing materials are suspected to be located within the building.

Building 34

Miscellaneous chemicals and fertilizers that may have been damaged in the October 2000 fire were identified in the first floor. On the second and third floors, small glass/metal laboratory bottles and metal pails were identified and may possibly contain hazardous materials. Demolition rubble was identified to be covering the ground surface outside of the building as well storage areas for empty drums. Lead paint and asbestos-containing materials are suspected to be located within the building.

Additional site information and background concerning the MCIDC property is presented in the Gannett Fleming, Inc. (GF) Phase I Environmental Site Assessment (ESA), dated December 2000.

A1b Corkins Property

The site is located at 233 East Third Street (actually includes 221 though 237 East Third Street), in the Borough of Lewistown, Mifflin County, Pennsylvania (Figure 1). The site is a commercial property that is occupied by Mr. Max Corkins and used as an antique automobile restoration shop. The site is situated over approximately 35,000 square feet, spanning three parcels and an alleyway, within a commercial/residential zone in downtown Lewistown.

Two of the three buildings located on the site are mainly block concrete buildings; the third structure is a small wooden carport. The property has been used for residential and light industrial purposes since 1896. Most recently the site has been used to restore and warehouse antique automobiles in various stages of repair.

The findings of the September 2000 Phase I ESA determined that environmental conditions on the site warranted further investigation. The site has been broken into discrete areas of concern based upon the particular findings at the site areas.

Building 2

Three (3) 55-gallon drums of waste oil and antifreeze were identified in the southwest corner of the building. An above ground storage tank (AST) for waste oil is located along the western edge of the building, although no staining was noted.

Parking Lot

Areas of localized soil staining were identified in the parking lot.

Additional site information and background concerning the Corkins property are presented in the Gannett Fleming Inc. Phase I Environmental Site Assessment (ESA), dated September 2000.

A1c Recreation Site

The site information and background concerning the Recreation property is presented in the attached Phase I Environmental Site Assessment (ESA), dated December 2002.

The subject site consists of approximately five acres of land located east of State Route 103 and immediately south and west of the Juniata River in Granville Township, Mifflin County,

Pennsylvania (Figure 1). The municipality of Lewistown, Pennsylvania is located north of the site across the Juniata River.

The site is developed with four wastewater treatment lagoons, four masonry settling basins, a small masonry storage building that is used for storage by Granville Township, and associated property. With the exception of the masonry building that is used for storage by Granville Township, located north of the settling basins, the subject site is not being used at the current time. However, during preparation of this Work Plan, two or more of the settling basins have been filled with aggregate in conjunction with road construction activities through the area (to provide access to the Township wastewater treatment plant).

The findings of the December 2002 Phase I ESA determined that environmental conditions on the site warranted further investigation. Based upon the particular findings at the site, the property will be treated as one area of concern.

Additional site information and background concerning the Recreation Site is presented in the ARM Group Inc. Phase I Environmental Site Assessment (ESA), dated December 2002.

A2 PROJECT DESCRIPTION

A2a MCIDC Plaza

The scope the Phase II assessment of the Plaza site is based on the results from the GF Phase I, GF's proposed Phase II SAP, and EPA's review comments of the GF SAP of December 2001. A significant portion of the Phase II activities described in the GF SAP include the characterization of containerized wastes that are located in Buildings 3 and 4; and determining whether any of the numerous areas of stained concrete flooring at Buildings 3, 4, and 33 are PCB-impacted. However, because these materials do not represent environmental media, but rather are waste materials that will later be disposed, or are portions of the buildings that do not represent any significant threat to the soil and/or groundwater at the site, ARM has proposed no sampling of these materials. Rather, the containerized wastes can be more cost-effectively characterized and removed from the site by a waste disposal vendor; and management of the stained concrete areas would be best determined after the future site redevelopment has been decided. ARM believes that limiting the Phase II assessment efforts at this site to only the areas where environmental media may be impacted will provide sufficient Phase II information necessary to proceed with the other site plans in a cost-effective manner (the other sampling can be performed as part of a subsequent phase of work under a different funding source).

The areas of the site that will be assessed include a wastewater subsidence basin at Buildings 7; rubble fill materials and soil east of Building 3; stained soil next to a transformer pad at Building 4; and, soil beneath the water tower. In addition, because of the historic use of significant quantities of hazardous/regulated materials at the site, and the resultant possibility of on-site spills or disposal of such materials, some subsurface investigation of the unpaved Plaza exterior areas will be performed. These areas will be selected during a pre-investigation site visit, the purpose of which will be to familiarize sampling personnel with the site features, including the health and safety issues. Sample locations are presented on Figure 2a, and sampling parameters are summarized on Table 1.

The subsidence basin sediment at Buildings 7 will be evaluated initially by performing a volume estimate of the concrete-lined structure. A composite sample of the subsidence basin sediment will be collected with a bucket auger. If an aqueous phase is present at the subsidence basin, a water sample will also be collected. Samples from the subsidence basin will be analyzed for priority pollutant metals (PPL metals), semi-volatile organic compounds (SVOCs), PCBs, volatile organic compounds (VOCs), pesticides, and cyanide.

The rubble fill and underlying soil east of Building 33, and the unpaved exterior areas selected for investigation, will be evaluated by hand excavation using a shovel and bucket auger. One composite soil sample from beneath the rubble will be collected (from a five-part composite) and analyzed for PPL metals, SVOCs, PCBs, VOCs and cyanides. Hand tools or a backhoe will be used, depending on conditions encountered, to evaluate the unpaved exterior areas selected for investigation. A total of four subsurface soil samples will be collected from exterior areas and will be analyzed for PPL metals, SVOCs, PCBs, VOCs, and cyanides.

The soil samples collected from the water tower and Building 4 transformer pad will be collected with hand tools. Two surficial samples and two deeper samples from the water tower area will be analyzed for total lead. One surficial and one deeper sample from the stained soils next to the transformer pad will be analyzed for PCBs.

The following laboratory methods will be used (also see Table 3):

- PCBs for soil, sediment, and water samples - USEPA Method 8082
- Priority Pollutant Metals for soil or water - USEPA Methods 200.7/245.1 or 6010B/7471A
- Priority Pollutant Semi-Volatile Organic Compounds (SVOCs) for soil, sediment or water - USEPA Method 625 or 8270C
- Priority Pollutant Volatile Organic Compounds (VOCs) for soil, sediment or water - USEPA Method 624 or 8260B
- Cyanides for soil, sediment or water - USEPA Method 335.2/9012A
- Priority Pollutant Pesticides for soil, sediment or water - USEPA Method 8081A
- Lead for soil - USEPA Method 7420

For mass spectral analyses (VOCs and SVOCs), the laboratory will be required to submit a Tentatively Identified Compound (TIC) list.

All chemical data will undergo the required data validation process. Results of data validation will be presented in the Phase II assessment report.

A2b Corkins Property

The Phase II work at the Corkins site, as recommended in the existing Phase I assessment report, includes the collection and analyses of three soil samples from two different locations at the site. Based on the ARM review of the Phase I report, the USEPA comments of the Phase II

recommendations, and a site visit, ARM agrees that the characterization of shallow soils near a drum storage area and at an oil-stained soil area is sufficient to address the Phase II requirements of this site.

The Phase II work at the Corkins site will be the collection of one soil sample from the drum storage area and two soil samples from the oil-stained soil areas. The soil sample from the drum area will be analyzed for PPL VOCs. The soil samples from the stained areas will be analyzed for PPL VOCs and metals, or PPL VOCs, SVOCs and metals. Sample locations are presented on Figure 2b, and sampling details are summarized on Table 1.

The following laboratory methods will be used:

- Priority Pollutant Metals for soil or water - USEPA Methods 200.7/245.1 or 6010B/7471A
- Priority Pollutant Volatile Organic Compounds (VOCs) for soil, sediment or water - USEPA Method 624 or 8260B
- Priority Pollutant Semi-Volatile Organic Compounds (SVOCs) for soil, sediment or water - USEPA Method 625 or 8270C

All chemical data will undergo the required data validation process. Results of data validation will be presented in the Phase II assessment report. For mass spectral analysis, the laboratory will be required to submit a TIC list.

A1c Recreation Site

The Phase II assessment at the Recreation site will include the assessment of the entire site. The presence or absence of hazardous materials in the vicinity of the basins and lagoons and in the subsurface at this site will be determined. ARM has evaluated available site information and has developed a Phase II work scope. Sample locations are presented on Figure 2c and are summarized on Table 1.

Samples of solid materials in the basins and other site features have been collected and analyzed by NUS Corporation, R.E. Wright Associates, Inc. and ARM at the Recreation site. Elevated concentrations of several metals and some organics were detected in these materials. Some sampling and analyses completed by MCIDC on the sludge existing in the four settling basins at this site confirmed the presence of some metals in the basin sludge. ARM has used this analytical data to better develop the Phase II work scope for this site.

The main tasks of the Phase II work scope for the Recreation site are as follows:

- Sampling of sludge/sediment in four lagoons for full Priority Pollutant suite (one composite sample from each lagoon, except for VOCs which will be collected based on field screening);
- Sampling of surface water in each lagoon for full Priority Pollutant suite (one sample from each lagoon, if water is present);
- Installation of three groundwater monitoring wells in vicinity of settling basins and lagoons;
- Collection of groundwater samples from three monitoring wells and analysis for Priority Pollutant VOCs, Semi-VOCs, and metals; and
- Collection of quality assurance/quality control samples from various media.

The full Priority Pollutant suite includes VOCs, SVOCs, pesticides/PCBs, and metals. ARM will collect and handle the various environmental samples according to USEPA and PADEP protocols and procedures to produce valid and defensible data. ARM will use specialized subcontractors to assist with the installation of monitoring wells, surveying, and laboratory analyses.

The sludge and sediment samples in the basins and lagoons will be collected with hand-held sampling equipment such as a hand auger or sediment sampler. The surface water samples will be acquired using dedicated plastic bailers. The planned monitoring wells will be drilled using percussion air rotary methods. The three monitoring wells will be constructed of 2-inch diameter PVC well screen and casing. The wells are planned to be approximately 20 to 25 feet deep and will penetrate at least ten feet of the groundwater zone near the basins. Groundwater samples will be collected from the wells using low-flow pumps and/or dedicated bailers.

The following laboratory methods will be used:

- PCBs for soil, sediment, and water samples - USEPA Method 8082
- Priority Pollutant Metals for soil or water - USEPA Methods 200.7/245.1 or 6010B/7471A
- Priority Pollutant Semi-Volatile Organic Compounds (SVOCs) for soil, sediment or water - USEPA Method 625 or 8270C
- Priority Pollutant Volatile Organic Compounds (VOCs) for soil, sediment or water - USEPA Method 624 or 8260B
- Priority Pollutant Pesticides for soil, sediment or water - USEPA Method 8081A

All chemical data will undergo the required data validation process. Results of data validation will be presented in the Phase II assessment report. For mass spectral analysis, the laboratory will be required to submit a TIC list.

A3 PROJECT TIME LINE

A project timeline is graphically depicted on the attached Figure 3. The actual schedule could vary based on agency review times, extent of any comments or concerns, weather conditions, the ability to secure access agreements, and related factors.

A4 MEASUREMENT QUALITY INDICATORS

Table 2 provides the measurement quality indicators for this project.

B. MEASUREMENT/DATA ACQUISITION

B1 SAMPLING DESIGN

ARM will collect and preserve all samples in the field and prepare the samples for transportation to GLA Laboratories (GLA) of King of Prussia, PA. GLA will be the primary analytical laboratory for sample analysis. See Appendix B for the laboratory's Qualification Package and other related materials. GLA will prepare and analyze the samples as indicated on Table 3, with all TICs indicated. GLA will make available to the EPA upon request all electronic tapes and other reference materials that are project related. GLA will hand deliver a hard copy and electronic version of the data deliverable to the data validation group Environmental Data Quality, Inc. (EDQ) which is located in Exton PA. See Appendix C for the Data Validation Qualification Package and other related materials. In addition, EDQ will make available to the EPA upon request all electronic tapes and other reference materials that are project related. Appendix D is a copy of the PADEP ACT 2 action limits that the data will be compared against.

B1a MCIDC Plaza

Table 3 provides the types and number of samples and analyses required for the MCIDC Plaza site. Figure 2a is a site map with specific sample locations. Table 1 contains the sample summary chart and general sample location identifiers.

B1b Corkins Property

Table 3 provides the types and number of samples and analyses required for the Corkins property. Figure 2b is a site map with specific sample locations. Table 1 contains the sample summary chart and general sample location identifiers.

B1c Recreation Site

Table 3 provides the types and number of samples and analyses required for the Recreation site. Figure 2c is a site map with specific sample locations. Table 1 contains the sample summary chart and general sample location identifiers.

B2 SAMPLING METHODS REQUIREMENTS

Table 1 provides information about the sampling techniques that will be used for this project. For specific details about the sampling procedures referenced in Table 1, refer to the appropriate sections of Appendix A, regarding SOPs. All samples will be collected

and preserved in accordance with procedures presented in Table 3. Field Quality Control Requirements for this sampling activity are found in Table 5.

B3 ANALYTICAL METHODS REQUIREMENTS

Table 3 provides information about the analytical methods (including any extraction or digestion methods) being used for this project. Additional information about analytical methods requirements, laboratory quality control requirements and laboratory equipment calibration procedures can be found in Appendix B.

B4 DATA MANAGEMENT

1.0 Sample Documentation

All sample documents will always be legibly written in ink. Any corrections or revisions to sample documentation shall be made by lining through the original entry and initialing any changes. To reiterate these requirements the following sub-sections are provided to outline sample documentation procedures that will be employed when conducting this Brownfields investigation.

1.1 Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate and factual account of field procedures may be reconstructed. All entries will be signed by the individuals who are making them. All field logbook entries will document the following specifics:

- Site name and project number.
- Contractor name and address.
- Names of personnel on site.
- Dates and times of all entries.
- Descriptions of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.
- Site observations.
- Identification and description of samples and locations.
- Subcontractor information and names of on-site personnel.
- Dates and times of sample collections and chain of custody information.
- Records of photographs.
- Site sketches.
- All relevant and appropriate information delineated in field data sheets and sample labels.

1.3 Standard Operating Procedures

Applicable SOPs have been incorporated into the data collection activities pursuant to this Brownfields investigation. To ensure environmental sample collection efforts are comparable, procedures found in sampling SOPs will be followed. The sampling SOPs are found in Appendix A.

1.4 Field Data Records

All real-time measurements and observations must always be recorded in project log books, field data records, or in similar types of record keeping books. Field data records will be organized into standard formats whenever possible, and retained in permanent files.

1.5 Analytical Data Deliverable Requirements

Level D plus

At a minimum, analytical data deliverable package for screening and definitive data will include the following:

- Sample documentation (location, date, and time of collection and analysis, etc.)
- Chain of custody
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantification
- Quality Control sample results (if applicable)

The laboratory will produce an analytical deliverable package. Prior to the submission of laboratory data, the laboratory's Quality Assurance Officer will review the data for accuracy, precision and completeness.

B.5 SAMPLING HANDLING AND CUSTODY REQUIREMENTS

Sample labels will be securely affixed to each sample container. Sample labels will clearly identify the particular sample, and delineate the following information:

- Site name and designated project number.
- Sample identification number and location.
- Date and time the sample was collected.
- Sample preservation method and analysis requested.

All samples will be maintained in accordance with the following chain of custody procedures. A sample is under custody when it is:

- In a person's physical possession
- In view of that person after he/she has taken possession
- Secured by that person so that no one can tamper with the sample
- Secured by that person in an area that is restricted to authorized personnel.

A chain of custody record must always be maintained from the time of sample collection until final deposition. Every transfer of custody will be noted and signed for with a copy of the record being kept for each individual who endorsed it. At a minimum, the chain of custody record will include the following information:

- Contractor name and address.
- Sample identification number.

- Sample location.
- Sample collection date and time.
- Sample information, i.e., matrix, number of bottles collected, container type, etc.
- Names and signatures of samplers.
- Signatures of all individuals who have had custody of the samples.

When preparing sample containers for shipment they will be securely sealed. Samples will then be put in an appropriate transport container and packed with an appropriate absorbent material. Samples placed in the transport container (e.g., coolers) will be packed in a manner that will prevent breakage. All sample containers will be packed to maintain a temperature of 4°C.

All sample documentation will be affixed to the underside of each transport container lid. The transport container lid will then be closed and affixed with a custody seal accordingly. Samplers will transport environmental samples directly to the laboratory within 24 hours of sample collection, or utilize an overnight delivery service within 24 hours of sample collection.

Custody seals on the transport container will be used to demonstrate that the transport container has not been opened or tampered with. The individual who has sample custody shall always sign, date, and affix the custody seal to the container in such a manner that it cannot be opened unless it is broken. When samples are not under direct control of the individual responsible for them, they will be stored in a container that will be affixed with a custody seal. When the transport container is received in the laboratory, the laboratory sample custodian will check the temperature blank to measure the temperature within the transport container and verify temperature is within QC limits.

C. DATA VALIDATION AND USABILITY

C1 REVIEW OF FIELD DATA

The analytical data will first be reviewed and validated by the laboratory according to their standard operating procedures. The Project QA Officer will then review the data and associated QC samples for the compliance with the conditions outlined in Tables 2 and 5. Data Usability will be determined after review by the Project QA Officer.

C2 DATA VALIDATION

To ensure that measurement data generated when performing this Brownfields investigation are of an appropriate quality, all data will be validated. Environmental Data Quality, Inc. (EDQ) which is located in Exton, PA will conduct data validation. For this limited project scope, data validation will consist of a review of the following:

- Use of appropriate Analytical Methodology
- Use of appropriate Reporting Limits
- Compliance with regulatory Holding Times
- Field Duplicate results
- Results of Field/Equipment Blanks, Trip Blanks and Temperature Blanks
- Review of Project-specific QC Samples, if applicable

C3 RECONCILIATION WITH USER REQUIREMENTS

1.0 Accuracy

Accuracy will be assessed through the analysis of quality control samples. The laboratory will evaluate analytical accuracy as the percent recovery (%R) of an analyte which has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation.

$$\%R = 100 \times \frac{S - U}{C_{sa}}$$

where:

%R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

The following formula should be used to for measurements where a standard reference material is used:

$$\%R = 100 \times \frac{C_m}{C_{rm}}$$

Where: %R = percent recovery
C_m = measured concentration of standard reference material
C_{rm} = actual concentration of standard reference material

1.1 Precision

Field precision will be determined through the collection of field duplicates. The laboratory will measure analytical precision through the use matrix spike/matrix spike duplicates and duplicate quality control samples. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

The following formula should be used to calculate precision:

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$$

Where: RPD = relative percent difference
C₁ = larger of the two observed values
C₂ = smaller of the two observed values

1.2 Completeness

Completeness is defined as the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria required by the prescribed analytical method.

$$\%C = 100 \times \frac{V}{n}$$

The following formula should be used to calculate completeness:

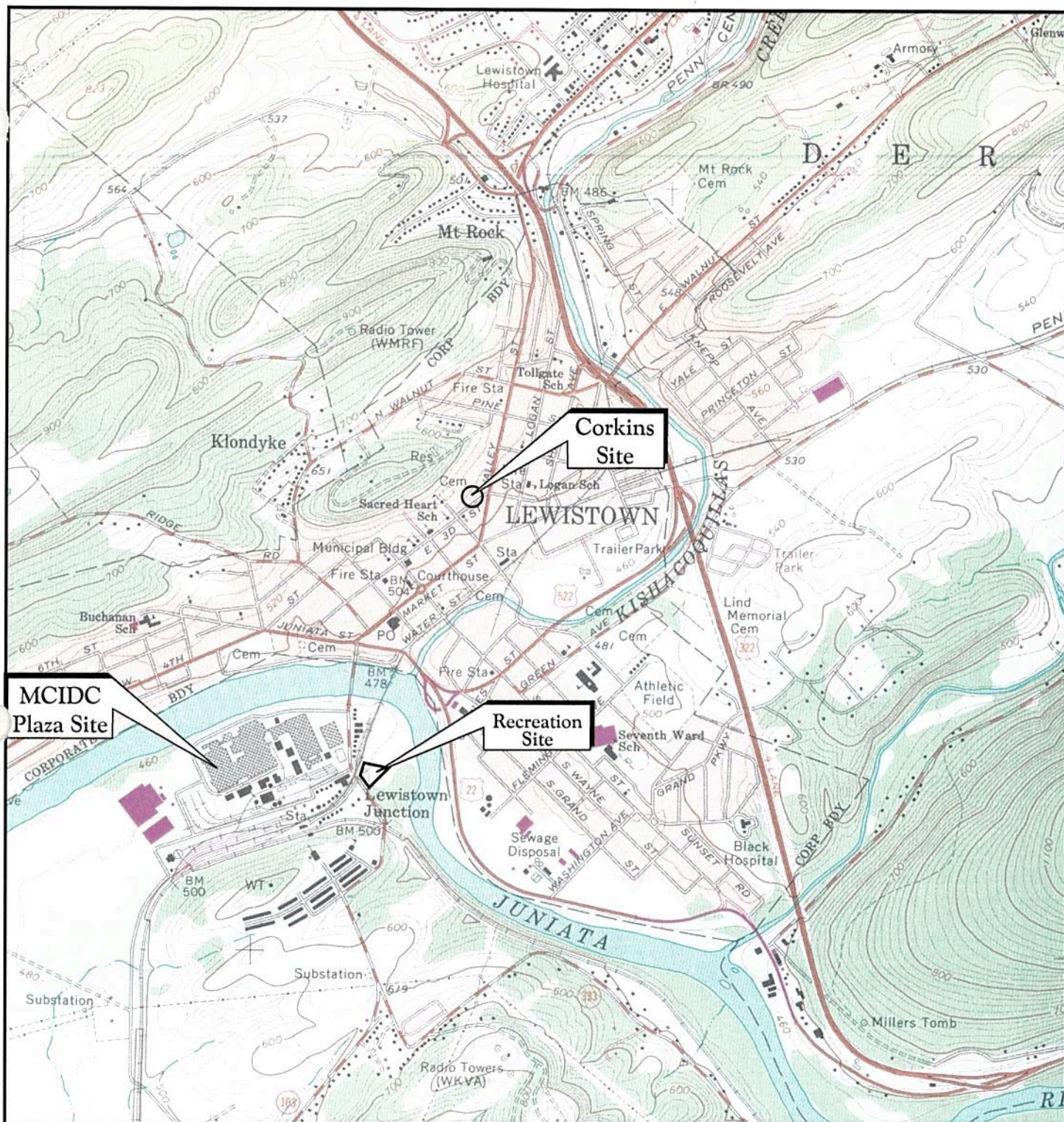
Where: %C = percent completeness

V = number of measurements judged valid

n = total number of measurements necessary to achieve a specified statistical level of confidence in decision making.

A completeness goal of 95% has been set for this project.

FIGURES



Base Map from the 1966 (Photorevised 1973) USGS 7.5 Minute Topographic Quadrangle of Lewistown, Pennsylvania



500 0 500 1000
SCALE IN FEET

Figure 1

Site Locations Map

Mifflin County Brownfields
Project Proposal
Mifflin County, PA

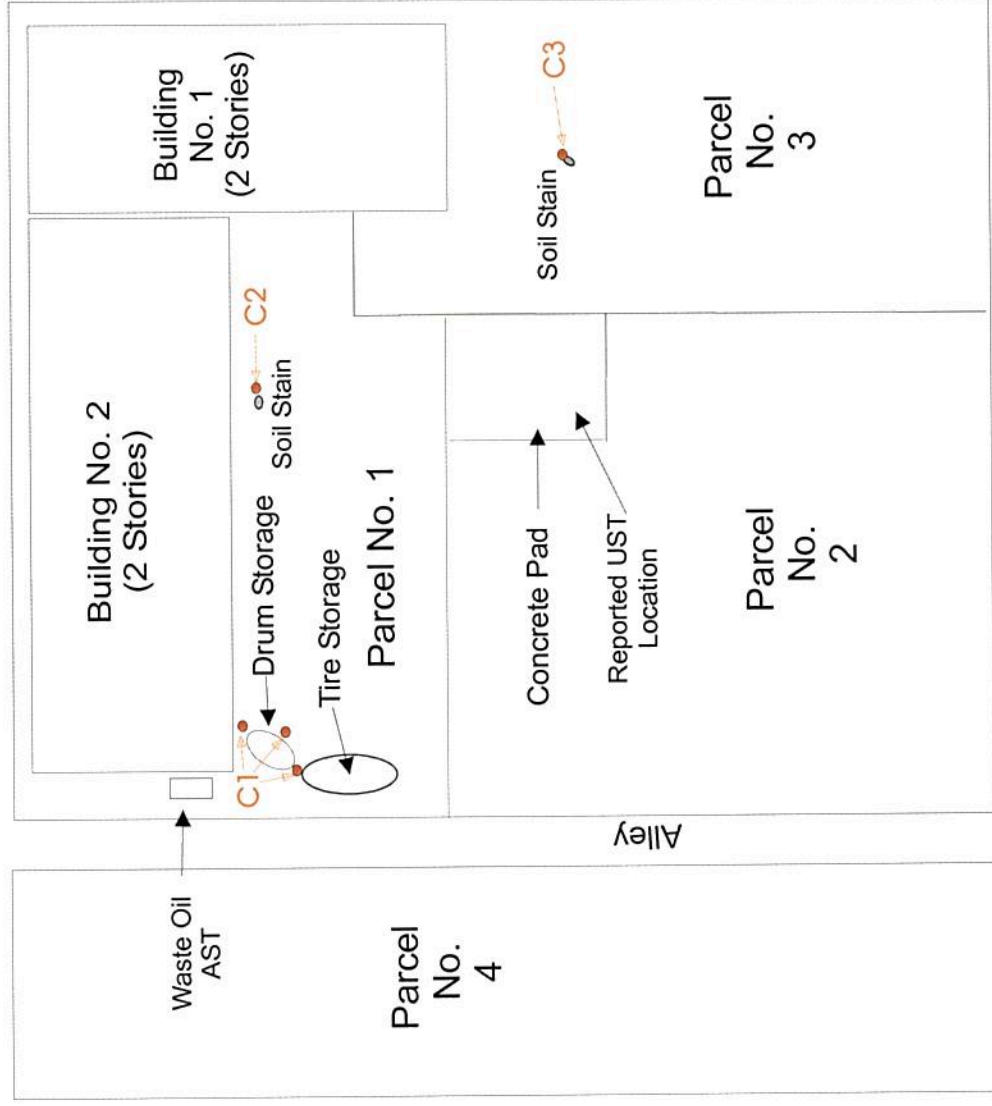
March 2003

02242



ARM Group Inc.
Earth Resource Engineers and Consultants
1129 West Governor Road • Hershey, PA 17033

Alley



Not To Scale

- Soil Sample Location
- C2 Table 1 Sample ID

Corkins Site

Lewistown, PA

Figure 2b

March 2003

02242



ARM Group Inc.
Earth Resource Engineers and Consultants

East Third Street



Not To Scale

- Soil Sample Location
- ⊗ Proposed Monitoring Well Location with Identifier
- R2 Table 1 Sample ID

Recreation Site

Granville Township,
Mifflin County, PA

Figure 2c

March 2003 02242



ARM Group Inc.
Earth Resource Engineers and Consultants

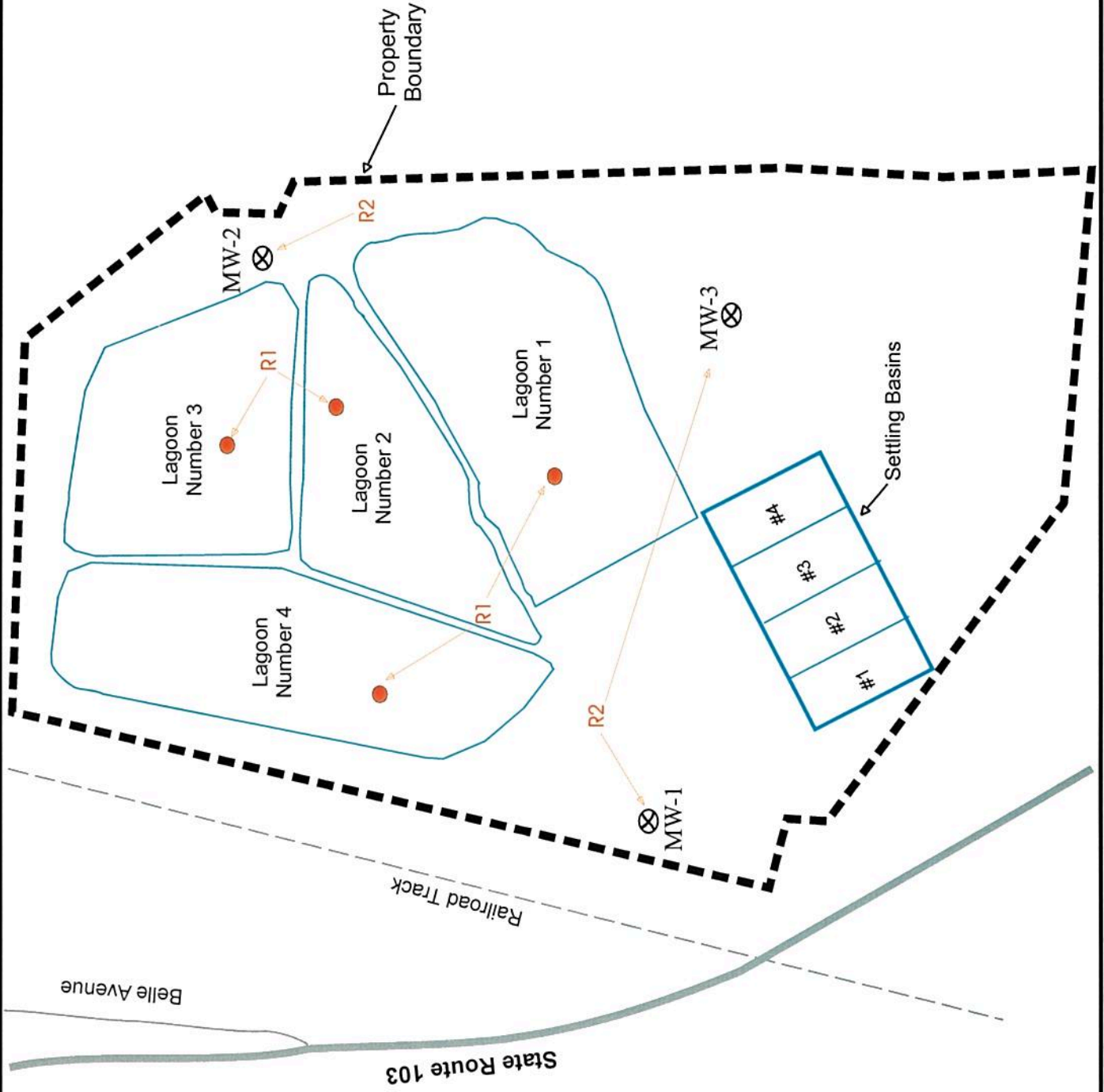
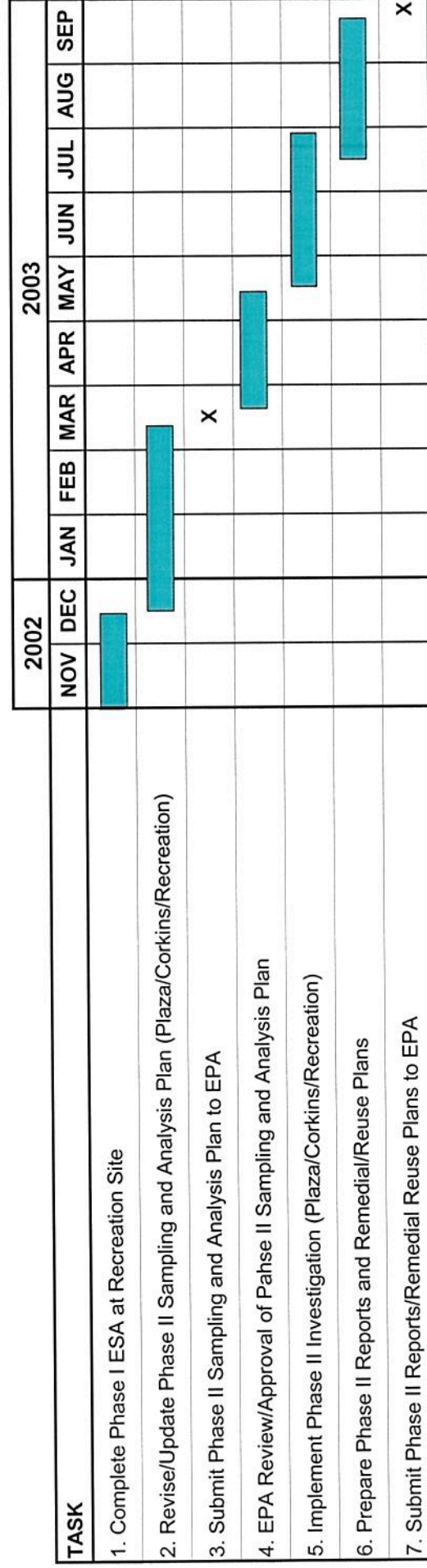


Figure 3
Timeline of Phase II Environmental Site Assessment Activities
Mifflin County Department of Planning and Development
Brownfields Pilot Project



Actual schedule could vary based on agency review times, weather conditions, access agreements, and similar conditions.

TABLES

TABLE 1
FIELD SAMPLING SUMMARY

MCIDC Plaza						
Sample ID	Building/Area	Location	Media		Type ⁽¹⁾	Justification
P1	4	Transformer Pad	Stained Soil	Soil	Composite	Sample stained soil around former transformer pad; 2 different depths.
P2	7	Settling Basin	Basin Water	Aqueous	Grab	VOCs, SVOCs, Metals, PCBs, Pest., Cyanide
		Settling Basin	Basin Sediment	Sediment	Composite	Sample settling basin water, if present.
P3	Building Debris & Fill Area	Areas containing Power House Building debris	Soil/Debris Fill	Soil/Debris	Composite	Sample settling basin sediment.
P4	Water Tower	Water Tower	Soil	Soil	Composite	Sample areas where the potentially contaminated building debris was used as fill material. One east of Bldg. 33, and 4 other selected areas.
Corkins Property						
Sample ID	Building/Area	Location	Media		Type ⁽¹⁾	Justification
C1	Parcel No. 1	Drum Storage Area	Stained Soils	Soil	Composite	Sample stained soil around drum storage area.
C2		Soil Stains	Stained Soils	Soil	Grab	Sample stained soils.
C3	Parcel No. 3	Soil Stains	Stained Soils	Soil	Grab	Sample stained soils.
Recreation Site						
Sample ID	Building/Area	Location	Media		Type ⁽¹⁾	Justification
R1	Lagoon Area	Lagoon Numbers 1 to 4	Basin Water	Aqueous	Grab	Sample standing water in lagoons, if present.
			Basin Sludge/Sediment	Sludge/Sediment	Composite	Sample lagoon sediment/soil.
R2	Lagoon/Basin Area	Near settling basins and lagoons	Groundwater	Aqueous	Grab	Sample local groundwater.

⁽¹⁾ Samples for VOC analysis will not be composited; rather, sampling will be based on the highest field PID reading.

⁽²⁾ VOC and SVOC analyses to include Tentatively Identified Compounds (TICs) Refer to Figures 2a, 2b and 2c for sample locations, and Table 3 for analytical methods.

TABLE 2
MEASUREMENT QUALITY INDICATORS

Compound	Matrix	Action Limit	Precision (For Field Duplicates)	Accuracy	Completeness
VOCs, SVOCs, Metals, PCBs, Pest., Cyanide	Soil	PADEP Act 2 Action Limits	35%	Less than the ERL	95%
VOCs, SVOCs, Metals, PCBs, Pest., Cyanide	Aqueous	PADEP Act 2 Action Limits	20%	Less than the ERL*	95%
VOCs, SVOCs, Metals, PCBs, Pest., Cyanide	Sediment	PADEP Act 2 Action Limits	35%	Less than the ERL	95%
VOCs	Sludge	PADEP Act 2 Action Limits	35%	Less than the ERL	95%
Lead	Soil	PADEP Act 2 Action Limits	35%	Less than the ERL	95%

Field blanks and trip blanks per Table 5.

PADEP Act 2 Action Limits, Appendix D = Statewide Health Medium-Specific Concentrations

ERL - Estimated Reporting Limit

* - Metals in the aqueous sample are excluded from the Accuracy criteria

TABLE 3
SAMPLING AND ANALYTICAL METHODS REQUIREMENTS

Matrix	Parameter ⁽¹⁾	Number of Samples	Sampling Procedure	Sample Preparation/Extraction Method Number	Analytical Method Number
Soil / Sediment	Semi-volatile Organics (SVOCs)	5	SOP 8, 11	SW 846-3500B	SW 846-8270C
Soil / Sediment	Cyanide	5	SOP 8, 11	SW 846-9012A	SW 846-9012A
Soil / Sediment	VOCs	5	SOP 8, 11	SW 846-5035	SW 846-8260B
Soil / Sediment	Pesticides	5	SOP 8, 11	SW 846-3500B	SW 846-8081A
Soil / Sediment	PCBs	5	SOP 8, 11	SW 846-3500B	SW 846-8082
Soil / Sediment	Total PPL Metals	5	SOP 8, 11	SW 846-3050B	SW 846-6010B & 7471A
Soil	Lead	4	SOP 8	SW 846-3050B	SW 846-7420
Soil	PCBs	7	SOP 8	SW 846-3500B	SW 846-8082
Soil	Semi-volatile Organics (SVOCs)	7	SOP 8	SW 846-3500B	SW 846-8270C
Soil	Total PPL Metals	7	SOP 8	SW 846-3050B	SW 846-6010B & 7471A
Soil	Cyanide	5	SOP 8	SW 846-9012A	SW 846-9012A
Soil	VOCs	8	SOP 8	SW 846-5035	SW 846-8260B
Basin Water	Semi-volatile Organics (SVOCs)	5	SOP 10	SW 846-3500B	SW 846-8270C
Basin Water	PCBs	5	SOP 10	SW 846-3500B	SE 846-8082
Basin Water	Total PPL Metals	5	SOP 10	SW 846-3010A	SW 846-6010B & 7470A
Basin Water	Pesticides	5	SOP 10	SW 846-3570C	SW 846-2081A
Basin Water	Cyanide	5	SOP 10	SW 846-9012A	SW 846-9012A
Basin Water	VOCs	5	SOP 10	SW 846-5030B	SW 846-8260B
Groundwater	Semi-volatile Organics (SVOCs)	3	SOP 9	SW 846-3510C	SW 846-8270C
Groundwater	Total PPL Metals	3	SOP 9	SW 846-3010A	SW 846-7000 & 6000
Groundwater	VOCs	3	SOP 9	SW 846-5030B	SW 846-8260B

SOP = ARM's Standard Operating Procedure document

⁽¹⁾ VOCs and SVOCs to include Tentatively Identified Compounds (TICs)

Table 4
Sample Handling Guide



ARM Group Inc.
Earth Resource Engineers and Consultants

Inorganic and Conventional Parameters

Parameters	EPA Method *	Container	Recommended Quantity (mL)	Preservative	Holding Time
Specific Conductance	120.1, 9050	P, G	100	4°C	28 days
Sulfate	300.0, 375.1, 375.3, 375.4, 9035/36, 9038, 9056	P, G	200	4°C	28 days
Sulfide	376.1, 376.2, 9030, 9031, 9215	P, G	500	4°C, Zn acetate, NaOH to pH >9	7 days
Sulfite	377.1	P, G	200	None	Immediately
Surfactants (MBAS)	425.1	P, G	250	4°C	48 hours
Total Organic Carbon (TOC)	415.1, 415.2, 9060	P, G	100	4°C, H ₂ SO ₄ or H ₃ PO ₄ to pH <2	28 days
Total Organic Halides (TOX)	9020	G-TLC (amber)	100	4°C, H ₂ SO ₄ to pH <2	28 days
Total Petroleum Hydrocarbon (TPH)	418.1, 1664, 8440	G-TLC	1000	4°C, H ₂ SO ₄ or HCl to pH <2	28 days
Turbidity	180.1	P, G	100	4°C	48 hours

Organic Parameters

Parameters	EPA Method *	Container	Minimum Quantity (mL)	Preservative	Holding Time
Purgeable Halocarbons	601, 8021	G-TLS	2x40	4°C	14 days
Purgeable Aromatics	602, 8021	G-TLS	2x40	4°C, HCL to pH <2	14 days
Volatile Organics	524, 624, 8260, CLP	G-TLS	2x40	4°C, H ₂ SO ₄ , HCl or NaHSO ₄ to pH <2	14 days 10 days - CLP
Pesticides (Organochlorine or Organophosphorous) and PCBs	608, 8081, 8082, 8141	G-TLC (amber)	1000	4°C, pH 5-8	7/40 days
Chlorinated Herbicides	615, 8151	G-TLC (amber)	1000	4°C	7/40 days
Semivolatile Organics (BNA), Polynuclear Aromatics	525, 625, 8270, 8310, CLP	G-TLC (amber)	1000	4°C	7/40 days 5/35 days for CLP

TCLP Parameters

Parameters	Holding Time from Collection to TCLP Extraction (days)	Holding Time from TCLP Extraction to Preparative Extraction (days)	Holding Time from TCLP/Preparative Extraction to Analysis (days)	Time Elapsed Time (days)
Volatiles	14	Not Applicable	14	28
Semivolatiles	14	7	40	61
Mercury	28	Not Applicable	28	56
Metals	180	Not Applicable	180	360

References: 40CFR Part 136 Tables IA, IB, IC, ID & IE and Table II, and others.

*The methods listed are for typical EPA references, except for SM, which refers to Standard Methods for the Examination of Water and Wastewater (18th Edition).

For bacteriological and organic parameters, add sodium thiosulfate if residual chlorine is present. Soil samples should be collected in 4-8 oz glass containers with a Teflon-lined cap and preserved at 4°C. No preservative required for waste samples except 4°C for volatiles. Teflon is a registered trademark of E.I. du Pont.

Acronym Definitions:

- 1). P - Polyethylene
- 2). G-TLS - Glass with Teflon-lined septum
- 3). G - Glass
- 4). PTFE - Fluoropolymer Resin / Teflon
- 5). G-TLC - Glass with Teflon-lined cap
- 6). EPA Contract Laboratory Program

Table 4 (continued)
Sample Handling Guide



ARM Group Inc.
Earth Resource Engineers and Consultants

Inorganic and Conventional Parameters

Parameters	EPA Method *	Container	Recommended Quantity (mL)	Preservative	Holding Time
Acidity	305.1	P,G	100	4°C	14 days
Alkalinity	310.1, 310.2	P,G	100	4°C	14 days
Ammonia	350.1, 350.2, 350.3	P,G	500	4°C, H ₂ SO ₄ to pH <2	28 days
Biochemical Oxygen Demand (BOD)	405.1, SM 5210	P,G	1000	4°C	48 hours
Boron	200.7, 212.3	P, PTFE, Quartz	200	HNO ₃ to pH <2	6 months
Bromide	300.0, 320.1, 9056, 9211	P,G	200	None	28 days
Chemical Oxygen Demand (COD)	410.1, 410.2, 410.3, 410.4, Hach 8000	P,G	100	4°C H ₂ SO ₄ to pH<2	28 days
Chloride	300.0, 325.1, 325.2, 325.3 9056, 9212, 9250/51, 9253	P,G	200	None	28 days
Chlorine, Residual	330.1, 330.2, 330.3, 330.4, 330.5	P,G	200	None	Immediately
Chromium VI	218.4, 7195, 7196, 7197, 7198, 7199	P,G	250	4°C	24 hours
Coliform, Fecal/Total	SM 9221, 9222	P,G (sterile)	100	4°C	6 hours
Color	110.1, 110.2, 110.3	P,G	100	4°C	48 hours
Cyanide	335.2, 335.3, 9010, 9012, 9013, 9213	P,G	1000	4°C, ascorbic acid, NaOH to pH >12	14 days
Fluoride	300.0, 340.1, 340.2, 340.3, 9056, 9214	P	500	None	28 days
Hardness	130.1, 130.2	P,G	100	HNO ₃ or H ₂ SO ₄ to pH <2	6 months
Iodide	345.1	P,G	200	4°C	24 hours
Metals	6010, 200, 7000 series	P,G	500	HNO ₃ to pH <2	6 months
Mercury	245.1, 245.2, 7470, 7471 7472	P,G	500	HNO ₃ to pH <2	28 days
Nitrogen, Kjeldahl (TKN)	351.1, 351.2, 351.3, 351.4	P,G	500	4°C, H ₂ SO ₄ to pH <2	28 days
Nitrate	300.0, 352.1, 9056, 9210	P,G	100	4°C	48 hours
Nitrite	300.0, 354.1, 9056	P,G	100	4°C	48 hours
Nitrate + Nitrite	353.1, 353.2, 353.3	P,G	200	4°C, H ₂ SO ₄ to pH <2	28 days
Oil and Grease	413.1, 1664, 9070	G	1000	4°C, H ₂ SO ₄ or HCl to pH <2	28 days
Phenols	420.1, 420.2, 9065, 9066, 9067	G	1000	4°C, H ₂ SO ₄ to pH <2	28 days
Phosphorus, Total	365.1, 365.2, 365.3, 365.4, 6010	P,G	200	4°C, H ₂ SO ₄ to pH <2	28 days
Phosphate, Ortho	300.0, 365.1, 365.2, 365.3	P,G	200	4°C	48 hours
PH	150.1, 9040, 9045	P,G	100	None	Immediately
Radiochemistry					
Alpha, Beta, Radium	900 & 9000 series	P	2000	HNO ₃ to pH <2	6 months
Tritium		G (amber)	100	None	6 months
Radon		G	3 x 40	None	4 days
I-131		P,G	1000	NaOH to pH >8	16 days
Silica	370.1, 200.7, SM1311D	P, PTFE, Quartz	100	4°C	28 days
Solids, Dissolved (TDS)	160.1	P,G	100	4°C	7 days
Solids, Suspended (TSS)	160.2	P,G	500	4°C	7 days
Solids, Volatile (TVS)	160.4	P,G	100	4°C	7 days
Solids, Total (TS)	160.3	P,G	100	4°C	7 days

TABLE 5
FIELD QUALITY CONTROL REQUIREMENTS

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Field Duplicate	One per twenty samples per matrix or one per day, whichever is more frequent	RPD \leq 50%	Quality Data/ Professional Judgment
MS/MSD	One per twenty samples per matrix or one per day, whichever is more frequent.	NA	NA
Equipment Rinsate Blank/Field Blank	One per twenty samples per matrix per equipment type per decontamination event or one per day, whichever is more frequent. Not required for dedicated, disposable equipment.	No compd \geq CRQL	Quality Data/ Professional Judgment
VOA Trip Blank	One for each cooler which contains samples for VOA analyses.	No compd \geq CRQL	Quality Data/ Professional Judgment
Cooler Temperature Blank	One per cooler.	4°C \pm 2°C	Quality Data/ Professional Judgment

TABLE 7
CALIBRATION AND CORRECTIVE ACTION-FIELD EQUIPMENT

Identify all tools, gauges, instruments, and other equipment used for data collection activities that must be calibrated to maintain performance within specified limits.

Instrument	Calibration Standards	Frequency Initial & Continuing Calibration	Acceptance Criteria	Corrective Action

APPENDIX A

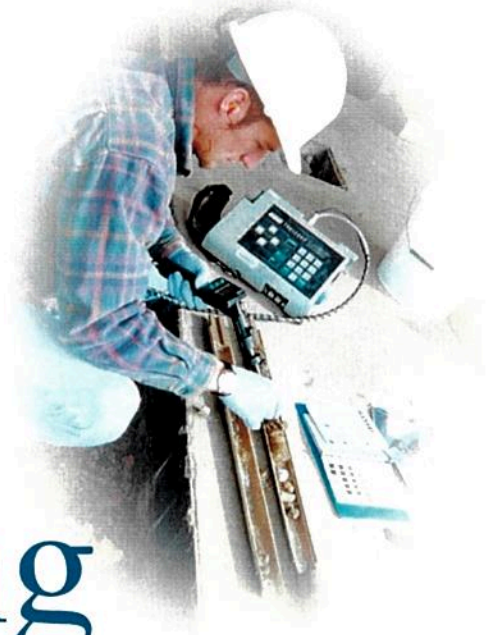
STANDARD OPERATING PROCEDURES



ARM Group Inc.

Earth Resource Engineers and Consultants

Standard Operating Procedures



Collection of Environmental Samples

2003

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION.....	1
2.0 PLANNING A FIELD INVESTIGATION	1
2.1 Identifying the Driving Force	1
2.2 Preparation of a Project Sampling Plan	1
3.0 PERSONNEL TRAINING.....	4
3.1 Health and Safety Training	4
3.2 Field Equipment Training	7
4.0 MONITORING WELL INSTALLATION	7
4.1 Drilling	7
4.2 Monitoring Well Construction in Unconsolidated Material	8
4.3 Monitoring Well Protocol in Bedrock	9
4.4 Decontamination of Well Installation Equipment	10
4.4.1 General Protocol	10
4.4.2 Soil Gas Decontamination Protocol.....	10
4.5 Monitoring Well Development Protocol in Unconsolidated Material.....	11
5.0 PREPARATION FOR SAMPLING	11
5.1 Equipment Procurement, Inspection, Calibration, and Maintenance.....	11
5.1.1 Equipment Maintenance	12
5.1.2 Calibration Procedures.....	12
5.2 Procurement and Preparation of Sample Containers	13
5.3 Storage and Handling of Sampling Gear	14
5.4 Decontamination Procedures	14
6.0 GENERAL SAMPLING PROCEDURES.....	14
6.1 Filtering Procedures	14
6.2 Measurement of Field Parameters.....	15
6.3 Field Quality Assurance Samples	15
7.0 TWO TYPES OF ENVIRONMENTAL SAMPLES.....	15
7.1 Discrete (Grab) Samples	15
7.2 Composite Samples.....	15
8.0 SOIL SCREENING AND SOIL SAMPLING PROTOCOL	16
8.1 Sample Collection From Soil Borings	16
8.2 Test Pit Soil Sample Collection Handling and Transport.....	17
8.3 Manual Soil Sample Collection	17
8.4 Field Headspace Analysis	18

TABLE OF CONTENTS (CON'T)

	<u>Page</u>
9.0 GROUNDWATER SAMPLING PROTOCOL	21
9.1 Sampling Set-Up.....	21
9.2 Groundwater Sampling Procedures	23
9.2.1 Monitoring Wells.....	23
9.2.1.1 Water Level Measurements	23
9.2.1.2 Monitoring Well Purging.....	23
9.2.1.3 Disposal of Purge Water	24
9.2.1.4 Sample Collection.....	25
9.2.1.5 Sampling Techniques and Methods.....	25
9.2.2 Residential and Municipal Wells.....	26
10.0 SURFACE WATER SAMPLING PROTOCOL.....	27
10.1 Preparation for Sampling	27
10.2 Sample Collection.....	28
11.0 SEDIMENT SAMPLING.....	30
11.1 Preparation for Sampling	30
11.2 Sample Collection.....	31
12.0 POST SAMPLING HANDLING	32
12.1 Sample Storage	32
12.2 Sample Shipment	33
13.0 DOCUMENTATION AND CHAIN OF CUSTODY.....	33
13.1 Field Data Sheets	33
13.2 Chain-of-Custody.....	35

ATTACHMENTS

Attachment 1	Standard Field Data Forms	Following Text
--------------	---------------------------------	----------------

1.0 INTRODUCTION

This document is ARM Group Inc.'s (ARM's) Standard Operating Procedures (SOP) for the collection of environmental samples, and includes procedures for sampling plan preparation, ARM personnel training, collecting environmental samples, and standard Quality Assurances/Quality Control (QA/QC) practices.

To the extent possible, the procedures in this document have been standardized to make them applicable to many types of environmental investigations. It must be recognized, however, that under many other site-specific conditions and/or regulatory programs, many of the procedures discussed herein may not be appropriate. In such cases, it will be necessary to adapt the procedures presented herein to the specific conditions of the investigation and regulatory setting. Such site-specific planning and adaptation should be done prior to starting the field effort to the extent possible, and should maintain consistency with applicable regulations and guidance.

This document will be reviewed annually and updated as necessary. Dates of revision to this document will be listed on the front cover. All ARM employees are invited to comment on these Standard Operating Procedures and to submit their comments in writing to the ARM Quality Assurance Manager.

All environmental sampling performed by ARM will be directed by a certified professional geologist, professional engineer, or equally qualified environmental professional.

2.0 PLANNING A FIELD INVESTIGATION

2.1 Identifying the Driving Force

Much of the environmental work conducted by ARM is "regulatory driven", which means a law or statute dictates how the investigation shall be conducted. Many of the laws or statutes also have associated guidance documents that detail the/ steps of the investigation. It is important that the driving force of the project be identified so that duplicate or unnecessary work is not done.

Circumstances in which the driving force is non-regulatory (i.e., voluntary), good technical judgment will define the scope of the investigation. All investigations should have a balance of cost effectiveness, timeliness and a sound technical approach suited to specific project goals.

2.2 Preparation of a Project Sampling Plan

Prior to the collection of environmental samples, it is necessary to prepare a project sampling plan which is site-specific. This will typically require determination of the following:

- (1) the objectives of the sampling program;
- (2) the media to be sampled;
- (3) the sampling locations; and
- (4) the analyses to be conducted.

Predetermination of these items will support the design and performance of a cost effective and technically feasible sampling plan. Projects requiring a site-specific Quality Assurance Project Plan (QAPP) will include many of the items discussed below for the Sampling Plan.

The three basic objectives of a sampling project are typically as follows:

- (1) determine the presence or absence of contamination;
- (2) determine the extent and magnitude of contamination; and
- (3) determine the contaminant pathways which may exist at a site.

The objectives of the Sampling Plan are to ensure the proper completion of the sampling program. Each of the above will greatly affect the design of the sampling plan, as each will subsequently affect the determination of the media to be sampled, the sampling locations, and the analyses to be conducted.

The second step in developing a Sampling Plan is the identification of the media to be sampled at a particular site. This may include the collection of surface and ground water samples, stream sediment samples, leachate springs or seeps, soil samples, air samples, hazardous materials, or solid waste. Again, the media to be sampled will be greatly affected by the objectives of the sampling.

The third step is to determine the sampling locations. In addition, it is necessary that the justification for the selection of the sampling locations be detailed along with the intended use of the data.

The fourth step is to determine what analyses will be conducted. The constituents analyzed are usually selected for several reasons:

- (1) required by regulations;
- (2) considered to be toxic and present at the site or there is an indication of their presence at the site;
- (3) indicators of contamination which may not be toxic; and/or
- (4) site-specific constituents or those constituents known to be present at the site, whether toxic or non-toxic.

All of the above factors will be dependent upon the work to be conducted at the site, whether it be a site investigation, feasibility study, and/or remedial design. In order to make informed decisions as to the above considerations, it is mandatory that all available background data on the site be collected and reviewed. Using this information, a detailed site-specific sampling plan for the investigation can be proposed. The plan should include, at a minimum, the following information:

- Preliminary Contacts - The Sampling Plan must identify a client contact to whom to communicate any problems, an ARM contact responsible for resolving sampling problems, and any other necessary contacts, such as responsible regulatory agencies.
- Review of Objectives for Sampling Program - The sampling objectives, as defined in the scope of work for the project, should be briefly reviewed. These might include the following:
 - Meet Regulatory Requirements.
 - permit conditions
 - agency requests or directives
 - Establish presence or absence of suspected compounds.
 - Determine types of classes of contaminants present and concentrations.
 - Determine migration pathways and direction(s). Determine boundary(ies) of contamination. Determine environmental/health factors.
- Sampling Locations/Media - A site location map indicating the sampling locations for each of the environmental media must be present in the Sampling Plan.
- List of Compounds and Analytical Methods - The list of compounds to be analyzed, as specified in the project scope of work, should be reviewed. The list should be sufficient to ensure that analyses and analysis methods will meet project objectives.
- List analytical methods, detection limits and data packages.
- Sampling Methodology.
 - Determine accessibility of the sampling locations.
 - Determine equipment to best accomplish the required sampling task(s).
 - Evaluate proper material selection [i.e. polyvinyl chloride (PVC), Stainless Steel or Teflon].
 - Evaluate concentration levels, which may influence methods chosen.
 - Determine types of samples to be collected:
 - Grab
 - Composite
- Sampling Order - If there are no previous analytical results, follow these guidelines:

- In general, proceed from the suspected background area(s) to the suspected source areas.
- For ground water, evaluate flow direction, with first sampling upgradient of the source area(s), then from downgradient proceeding toward the source area(s).
- For surface water, sample downstream stations first and proceed toward upstream stations to minimize effects of suspended sediment.
- If sediment and surface water samples are to be collected, always collect the water samples before the sediments.
- If previous analytical results are available, proceed from the least to most contaminated locations.

The sampling plan must include quality assurance (QA) samples as required in the project scope of work to provide accurate and reliable data. Specific types of QA samples collected in the field are discussed in Section 6.

All non-disposable equipment must be decontaminated prior to use and between sampling locations. The methods must be specified in the sampling plan, and must be compatible with the analytical parameters and concentration levels expected. Appropriate methods are described in Section 5.4.

The remaining sections of this document describe activities and methods that are performed and used throughout an environmental investigation. These activities and methods are to be used where applicable in the development and performance of the Sampling Plan.

3.0 PERSONNEL TRAINING

3.1 Health and Safety Training

Site personnel associated with those field activities in which the potential for exposure to hazardous substances above the Permissible Exposure Limit (PEL) are required to participate in a health and safety training program that complies with criteria set forth by ARM and OSHA as per interim final regulation, 29 CFR 1910.120. This program instructs employees on general health and safety principles and procedures, proper operation of monitoring instruments, and use of personal protective equipment.

There must be a task-specific Health And Safety Plan written for all major phases of field work be conducted on any project. The personnel working on any task must have read and be thoroughly familiar with that plan.

In addition, site employees should undergo site-specific training prior to the start-up of any given project or task. As activities change at a particular site, related training will address potential hazards and associated risks, site operating procedures, emergency response and site control methods to be employed.

Specialized training is provided as dictated by the nature of site activities. Specialized training provides for activities such as confined space entry, excavations and handling of unidentified substances. Employees involved in these types of activities are given off-site instruction regarding the potential hazards involved with safety activities and the appropriate health and safety procedures to be followed. Off-site instruction is meant to include any area where employees will not be exposed to site hazards.

Exhibit 1 lists the areas in which all applicable employees must have received training, at a minimum. Site personnel involved in the field activities will have received the appropriate basic training plus additional specific training where needed. Specialty training shall be provided as defined by task and responsibility. All training of personnel is conducted under direct supervision of a trained Health and Safety Officer.

EXHIBIT 1

PERSONNEL TRAINING REQUIREMENTS

All applicable employees must have, at a minimum, received training in the following areas:

1. Safety and Health Officer and Site Management Responsibilities - Personnel must understand Safety Officer and Site Management responsibilities and authority.
2. Site-Specific Health and Safety Hazards - Personnel must be informed of specific hazards related to site and site operations, such as health hazards of site chemicals and specific safety hazards of process equipment.
3. Personal Protective Equipment (PPE) - Personnel must be trained in proper use of personal protective equipment.
4. Safe Work Practices/Engineering Controls - Personnel must be informed of appropriate work practices and engineering controls that will reduce the risk of exposure to site hazards.
5. Safety Equipment Use - Personnel must understand the use of monitoring instruments and other safety equipment.
6. Medical Surveillance program - Personnel must be informed of requirements for medical surveillance of hazardous waste site employees.
7. Site Control Methods - Personnel must understand site methods used to reduce exposure to on-site and off-site personnel.
8. Decontamination Procedures - Personnel must be trained in proper decontamination operations and procedures to include decontamination of PPE, equipment, and vehicles.
9. Emergency Response - Personnel must be trained in proper emergency response operations and procedures.
10. Confined Space Entry/Special Hazards - Personnel involved in specific hazardous activities, such as confined space entry and drum handling, must receive training in appropriate techniques to employ during such operations.

3.2 Field Equipment Training

In an attempt to standardize the use of ARM field sampling and data acquisition equipment, an equipment training program has been established. All ARM field employees are required to receive the training before embarking on any field work. While reducing the wear and tear on the equipment, the training is also designed to ensure that all field personnel use the equipment in the proper manner, and follow the appropriate decontamination procedures in order to help maintain sample and data integrity. All personnel who may be involved in field activities will be totally familiar with ARM field equipment and the proper use thereof.

The training is conducted by ARM's Senior Field Technician, who has over 15 years of experience performing environmental sampling activities. The course covers hands-on training for the following equipment: centrifugal pumps (purging any shallow, high yielding well); submersible pumps; the Photovac MicroTIP (organic vapor analyzers); photoionization detectors (PIDs); flame ionization detectors (FIDs); groundwater parameter meters (pH and conductivity); depth-to-water meters; oil/water interface probes; soil gas survey equipment; power and hand driven stainless steel augers; soil sampling bucket augers; electric generators; steam cleaners; explosimeters; the Millipore[®] positive pressure filtration apparatus; and proper sample documentation, packing and shipment.

A considerable amount of emphasis is placed on the proper decontamination and handling of all the above equipment; however, each project has its own specific decontamination procedures that will be followed.

4.0 MONITORING WELL INSTALLATION

4.1 Drilling

ARM monitoring well installation projects are supervised by a Certified Professional Geologist with field drilling activities being conducted by an ARM geologist, environmental scientist, or geotechnical engineer (referred to as a field representative). The professional geologist will ensure that all ARM personnel, involved in the project, including the ARM field representative reviews and understands the proposed monitoring well installation program prior to the initiation of field work. Drilling will be accomplished by a well driller certified in the specific state in which the project takes place. *Well drilling and construction procedures must be adjusted as appropriate to meet the applicable state/agency requirements.*

Soil and or rock sampling, conducted as part of the well installation program, will be performed as specified in the project work plan. However, sampling of unconsolidated materials is generally performed using either 2-foot long split spoon sampling devices or acetate GeoProbe sleeves. Upon retrieval from the subsurface the ARM field representative will log the samples in a field log book or on a site-specific logging form (see Attachment 1). Descriptions of the subsurface samples will be recorded as discussed in Section 8. Representative samples will be retained in plastic zip-lock bags or glass jars for future examination. In the event that samples

are collected for laboratory analyses, the samples will be collected based on appropriate protocols for the specific constituents to be analyzed and stored in specified containers as described in further detail in Section 5. When sampling is accomplished using split spoon sampling devices, standard penetration testing (SPT) results and percent of material recovered in the sampling device (percent recovery) will be recorded by the field representative in the log book or other appropriate form. The SPT data will indicate the number of blows required to advance the split spoon six inches into unconsolidated material. Percent recovery will also be recorded when collecting samples using GeoProbe equipment.

All cuttings produced during drilling operations will initially be discharged to plastic sheeting, placed over the ground surface in close proximity to each well drilling location. Depending on site requirements, the cuttings are to be subsequently placed in either 55-gallon DOT drums for ultimate removal from the site or, when agreed upon by the site owner, the project manager and field representative, the field representative may elect to retain the cuttings on plastic sheeting for future handling. The cuttings retained on plastic sheeting will be gathered and staged away from high traffic areas and will not be left in separate piles adjacent to the newly installed wells. The cuttings will be covered with plastic and that plastic covering will be thoroughly secured to ensure that the cuttings are not blown or washed from the sheeting. Final disposition of the cuttings (whether drummed or staged on plastic sheeting) will be determined based on the results of laboratory analyses performed on representative samples of the cuttings. The cuttings will be analyzed for constituents expected to be present at the site based on use and historic operation of the site, and the requirements of licensed waste recycling/disposal facility requirements. The cuttings shall remain secured on the sheeting or in the drums until disposition of the cuttings can be determined based on analytical results.

During drilling operations appropriate air monitoring devices (PIDs or FIDs) will be used to monitor the field workers' breathing space and to perform field screening on the materials being retrieved from the subsurface. Measurements taken of breathing space will be used to determine the proper level of personal respiratory protection. ARM's field representative (whether that individual is a site health and safety officer or the technical professional) will be responsible for specifying the appropriate level of respiratory protection for all ARM staff on site and for the subcontractors on site. Air quality measurements taken of the materials from the subsurface will be logged in the field book or other specified logging forms.

Depending on regulatory requirements, the project sampling and analyses plan may require that the drilling rig and downhole equipment be decontaminated prior to any on-site drilling operations. Subsequently, all downhole equipment may require decontamination between drilling locations and split spoon sampling devices and other non-disposable sampling devices may require decontamination between samples.

4.2 Monitoring Well Construction In Unconsolidated Materials

A basic design will be followed to maintain uniformity during the construction of monitoring wells in unconsolidated materials. This basic monitoring well design includes the following elements:

- Two- or four-inch diameter, Schedule 40, threaded, flush-joint PVC factory slotted screen and riser pipe;
- Silica sand pack material graded to specifications for the screen slot size and soil particle size placed two to three feet above the top of the screen;
- Two feet of bentonite chips (hydrated) or pellets above the sand pack and bentonite grout, chips or pellets, as appropriate, to seal all specified remaining intervals of the borehole annulus;
- At least 2.5 feet of well casing “sticking up” above ground level (for stick-up well completion) or casing cut-off at least 5 inches below grade (for flushmount well completion). Stick-up completion will require the installation of a steel protective cover installed in concrete at least 0.5 feet below grade with a concrete apron constructed around and sloping away from the well. The inner well casing will be fitted with a watertight cap. Either the inner casing or outer protective cover will be completed with a locking cap. The annular space surrounding the flushmount well casing will be filled with concrete and a steel manhole cover will be installed to cover the well. The manhole cover will be bolted in-place and the inner well casing will be installed with a watertight, locking cap.

4.3 Monitoring Well Protocol in Bedrock

The following protocol specifies the procedures to be followed by the ARM field representative directing drilling for the installation of monitoring wells in competent bedrock. These wells will be completed as open holes to monitor water-bearing zones (WBZs) in the bedrock.

1. Drilling will begin using an eight-inch diameter roller bit or air hammer. The field representative will log all soil and rock cuttings at five-foot intervals or ten-foot intervals, depending on the drilling equipment being used.
2. A nominal eight-inch diameter borehole will then be drilled approximately ten feet into competent bedrock. Five-inch diameter, welded, carbon steel casing with a steel drive shoe will be set and driven into the bottom of the eight-inch borehole.
3. The annulus formed by the five-inch casing inside the eight-inch borehole shall be sealed with bentonite/concrete slurry and pumped from the bottom up using a tremie pipe and a high pressure grout pump.
4. The contractor shall then drill a nominal five-inch diameter borehole below the five-inch casing to an approximate depth of five feet below the occurrence of a monitorable well yield.
5. When the well has been drilled to total depth, it will be developed with rig air until visual

clarity is achieved at the depth of the target WBZ.

6. Cleanup of each drill site will include placing all drill cuttings in drums or staged on site on plastic sheeting, as specified previously. Cuttings staged on plastic sheeting will be secured with a plastic cover. Immediately following the receipt of laboratory analyses, cuttings will be either used on or off-site or disposed of at a licensed waste disposal/recycling facility, depending on the results of the laboratory analyses. All plastic and other non-earth debris generated by well installation operations will be placed in plastic garbage bags, which will then be placed into containers for proper disposal.

4.4 Decontamination of Well Installation Equipment

4.4.1 General Protocol

In order to reduce the potential for contamination of groundwater samples from drilling equipment and well construction materials, several precautions will be taken, as follows:

- Well casing materials including riser pipe and screens will be steam-cleaned immediately before use unless it is delivered in intact sealed plastic wrappings which are certified by the manufacturer to be factory-decontaminated for monitoring well use.
- The screen and pipe will be lowered into the borehole by hand so they do not contact the drilling equipment during the installation process. Additionally, all workers handling these materials will wear new, clean disposable vinyl or latex gloves.
- When necessary, only vegetable-based lubricants will be used on any threaded pipe connections or auger connections, which enter or can be in contact with tools which enter the well bore.

4.4.2 Soil Gas Decontamination Protocol

Point driver apparatus will be cleaned as follows:

1. Fill a clean plastic tub with warm tap or deionized water to a depth of several inches.
2. Add a surfactant, such as Alconox, to the tub water and thoroughly mix until sudsing occurs.
3. Brush loose dirt from the outside of the down-hole equipment (DHE).
4. Place the DHE in the tub and clean one at a time with a different brush that has been cleaned with soap and warm water.
5. Clean the inside of the DHE with a wire bristle pipe cleaner or brush.

6. When all debris has been removed from the inner and outer surfaces of the DHE, rinse using deionized organic-free water. Rinse water should be contained in the cleaning tub.
7. Allow to air dry and store the DHE in heavy-duty plastic bags for use at another location.
8. Latex gloves are to be worn during the cleaning process. Fresh gloves must be worn for each cleaning event.

4.5 Monitoring Well Development Protocol in Unconsolidated Materials

Initial development to remove fines from the sand pack and surrounding formation will be performed using a: 1) peristaltic pump; 2) Waterra-brand pump; or 3) a PVC, weighted PE or stainless-steel purge bailer. If a pump is used, the position of the tubing intake will be varied through the entire screen length during this process.

The well will be pumped or bailed until field parameters stabilize or at least three to five well volumes are removed, whichever is longer. Conditions will be considered to have stabilized when:

1. the discharge achieves visual clarity;
2. the range in pH values for three consecutive well volumes is within 0.5 pH units;
3. specific conductance is within ten percent for three consecutive well volumes; and
4. temperature is within 2°C for three consecutive well volumes.

Documentation regarding produced water clarity during development will be maintained on well development field data sheets. Development water will be contained and properly disposed of.

5.0 PREPARATION FOR SAMPLING

This section describes the procedures to be followed by field sampling personnel prior to the initiation of the sampling events.

5.1 Equipment Procurement, Inspection, Calibration, and Maintenance

Prior to the sampling event, sampling equipment will be inspected to verify cleanliness and to ensure proper working order. Worn parts will be replaced before the sampling event.

Preventive maintenance of field measuring instruments and field sampling devices will be accomplished during the sampling event by daily inspection of these instruments and sampling devices.

Field parameter data (i.e., pH, temperature, and specific conductance) will be collected using a field meter. The field meter will be calibrated each sampling day for pH and weekly for specific conductance.

5.1.1 Equipment Maintenance

Routine daily maintenance procedures must be conducted in the field to ensure that equipment is operable. The types of field maintenance to be performed include the following:

- Removal of surface dirt and debris.
- Replacement of disposable parts (i.e, OVA filters, probe membranes, etc) as required by the equipment manuals.
- Storage of equipment in a secure, dry place, protected from dust, wind, and precipitation.
- Daily inspections of equipment and instruments for possible problems e.g. cracked or clogged lines or tubing, weak batteries).
- Checking of instrumental calibrations as described in the equipment manual.
- Charging battery packs for equipment when not in use, or when necessary.

The equipment/instrument operator will ensure that appropriate replacement parts accompany all equipment in the field.

5.1.2 Calibration Procedures

Equipment calibration ensures that measurements obtained are accurate in reference to a known standard. ARM will calibrate equipment/instrumentation as recommended by the manufacturer in the equipment manuals.

Calibration solutions should be dated, and attention will be paid such that valid solutions are used.

Calibration procedures are summarized below:

- **pH and specific conductance meters** will be calibrated a minimum of once daily in the field, and documented in the calibrator's field book. Calibration will be checked as necessary to ensure proper measurements are taken.
- **pH meters** will be calibrated using specific techniques according to the manufacturer's instruction using two standard buffer solutions (either 4, 7, or 10) obtained from chemical supply houses. The pH values of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured below) at which the sample pH was measured will then be used to compensate for temperature on the meter [temperature measurements will be performed using field thermometers (Thomas Science No. 939A10) or equivalent)].

- **Specific conductance meters** will be calibrated in the field using a 1,000 umhos/cm (KCl) solution. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{E}{C}$$

Where: K = probe cell constant (unitless)
 C = measured conductance value of standard (umhos/cm)
 E = expected conductance at the observed standard solution temperature.

The equation below is used to correct for the standard solution's conductivity value if it is not at 25° C.

Using the cell constant calculated above and the following formula, field specific conductance measurements must be corrected to 25° C.

$$S = \frac{KC}{1 + 0.2 (T-25)}$$

Where: S = specific conductance at 25° C
 K = calculated cell constant
 C = field specific conductance (umhos/cm)
 T = temperature (° C) of sample at which conductance was measured

Other instruments will be calibrated according to Manufacturer's Guidelines.

5.2 Procurement and Preparation of Sample Containers

Samples shall be placed into laboratory-prepared containers. These containers shall be prepared per approved Pennsylvania Department of Environmental Protection and USEPA procedures. Field personnel shall collect samples in appropriate containers for the analytical methods. The required containers, preservatives, and holding times are listed in Table 1 (below).

Table 1: Sampling Containers, Preservatives, and Holding Times			
Analyte	Sample Container	Preservative	Holding Time
Volatile Organics	Glass	P-1a P-1b	7 days 14 days
Acid Extractable Organics	Glass	P-1a	7 days/40 days**
Base Neutral/Extractable Organics	Glass	P-1a	7 days/40 days**
Pesticides/Herbicides/PCBs	Glass-Amber	P-1a	7 days/40 days**
Metals	Polyethylene***	P-2	6 mos., except Hg (28 days)

**	Maximum holding time from sample collection to sample extraction is 7 days; maximum holding time to analysis for extract is 40 days.
***	Fluorocarbon resin may also be used.
P-1a	Cool to 4°C.
P-1b	Preserve with NaHSO ₄ or concentrated HCl, cool to 4°C.
P-2	Preserve with concentrated HNO ₃ to pH<2, cool to 4°C.

5.3 Storage and Handling of Sampling Gear

Sampling equipment will be stored in such a way and in such a place as to prevent contact with contaminated equipment or materials. Whenever possible, dedicated sampling equipment shall be used to reduce the need for field decontamination of equipment. Purging and sampling equipment must be handled with gloved hands. These gloves shall be changed following each activity that may contaminate them and, at a minimum, between wells.

5.4 Decontamination Procedures

When possible, sampling equipment shall be disposable and come from the factory clean and wrapped in sealed plastic. All non-dedicated well sampling and evacuation devices shall be decontaminated before placement down the borehole using the following procedure:

- Remove any soil or debris with a brush,
- Rinse with tap water,
- Wash with non-phosphate detergent,
- Rinse with pesticide grade acetone or methanol,
- Rinse at least two times with dionized (DI) water, and
- Allow equipment/devices to air dry.

Non-dedicated field measurement devices such as water level indicators and pH, temperature, and conductivity instruments shall be decontaminated before obtaining a measurement in such a manner so as not to damage the equipment. This non-dedicated field equipment shall be decontaminated by thoroughly rinsing with DI water.

6.0 GENERAL SAMPLING PROCEDURES

6.1 Filtering Procedures

Dissolved metals, base neutral/acid extractable (BN/AE) constituents, pesticides, and polyvinyl chlorinated biphenyl (PCB) samples may be field-filtered (if approved by the regulatory agency) through a 0.45-micron filter made of Teflon[®], polypropylene, nylon, cellulose, or borosilicate glass. A new disposable cartridge-type filter, sample transfer bottle (if necessary), and tubing shall be used for each sample collected. Samples shall be collected into clean sample transfer containers or directly from discharge tubes before undergoing filtration and shall be filtered immediately into properly preserved sample containers.

6.2 Measurement of Field Parameters

Field parameters (i.e., pH, specific conductance, and temperature) will be determined using a field meter after all containers have been filled following the sampling order specified in Table 2 (in Section 9.2). If practical, measurements will be taken in-situ, otherwise field measurements may be taken at the surface. Once the measurement node is submerged (in-situ), the actual measurement will be recorded after the meter reading has stabilized. Field measurement will be recorded in the sampling log book.

6.3 Field Quality Assurance Samples

1. A **trip blank** shall be prepared for each aqueous media sampling round by the laboratory using organic-free deionized water. This trip blank shall be analyzed for VOCs after accompanying the sampling vials from the laboratory to the field sampling locations and back to the laboratory in the sample cooler.
2. A **field duplicate** shall be collected once per ten aqueous media samples and analyzed for VOCs.
3. One **equipment rinse blank** shall be collected from a decontaminated bailer during the first round of sampling and analyzed for VOCs.

7.0 TWO TYPES OF ENVIRONMENTAL SAMPLES

Two general types of samples can be collected: composite and discrete (grab) samples. These types apply to all different sampling media. Composite samples are taken from several different locations (depths), or at several different times, or over a certain amount of water flow. Discrete samples are collected at a single point in time, from a single location or over a discrete depth interval.

7.1 Discrete (Grab) Samples

Discrete samples must be collected under the same conditions for all constituents. All the water volume needed for a discrete monitoring well sample must be collected from the same depth in a well.

- If more than one bailer full of water is necessary to fill the appropriate sample containers, then care must be exercised that the bailer is lowered to the same level in the well each time.
- Discrete soil samples must, likewise be collected from the same depth and location at each sampling point.

- Discrete surface water samples must be collected from one point, and at one depth, to fill all the necessary sample containers.

7.2 Composite Samples

Samples can be composited based on sample volume, sample depth, sample weight, flow rates, or time. Regardless of the criteria determining the frequency of sample collection and the media being sampled, basic rules apply to all composite samples.

- Samples to be analyzed for volatile organics should not be composited. Because compositing involves combining of the individual subsample, and that usually involves extra exposure to the air. Volatile organic constituents are lost in the compositing process.
- Regardless of the media, equal parcels of sub-sample must be combined to form the composite. This may mean equal volumes of water from each sub-sample or equal weights of soil or sediment. For composites based on time or flow rates, equal volumes must be collected over constant intervals between subsamples.
- Care must be exercised to insure that any sample implements used in the compositing process are thoroughly decontaminated, so that the representativeness of each subsample is maintained.

The above guidelines can be applied to the collection of any of the types of samples that are described in the following sections.

8.0 SOIL SCREENING AND SOIL SAMPLING PROTOCOL

8.1 Sample Collection From Soil Borings

ARM typically collects soil samples from boreholes drilled with the assistance of a drilling or probing rig and crew. These samples are generally collected using either split spoon sampling devices or GeoProbe sampling devices (acetate sleeves). These sampling devices must be properly decontaminated and when assembled, threading cannot be lubricated with petroleum-based substances. When each sample is brought to the surface by the drilling contractor, it will be turned over to the ARM field representative after the ends of the sampler have been removed but before the split barrel or sleeve have been opened. The field representative will be responsible for opening the sampling device, at which time the sample will be screened using an FID or PID by holding the detector wand over each sampling device as it is opened but prior to being otherwise physically disturbed. The sampling representative will wear surgical or latex gloves during sample collection. The gloves will be changed between samples. A soil sample will be collected for laboratory analysis from each split spoon/acetate sleeve exceeding a prescribed gas level or in the manner specified in the site-specific sampling and analyses plan. The length of recovery will be measured and recorded on the log, and the sample will be cut in

half longitudinally using the clean stainless steel knife or spatula. The sample will then be logged for lithology, texture, weathering, color, density, moisture, sample depth interval, penetration, recovery, and drilling rate with a description following the United States Department of Agriculture (USDA) Soil Classification System or as indicated in the site-specific sampling and analyses plan. If no sample is to be retained for chemical analysis in the laboratory, the sample will be placed in a glass jar or plastic zip-lock bag, which will be individually labeled with the boring number, the split-spoon sample number covering the entire 24-inch interval (e.g., SS1), the depth interval of the sample, the blow counts for the entire 2-foot sample interval, and the date the sample was collected.

From each of the samples for which a chemical analysis is requested or required, a soil sample will be carved out of the inner portion of the sample using a decontaminated stainless steel spatula. An encore sampler, field preservation with methanol, or similar sampling methods may be used for sample collection, pending the applicable regulatory program. Each sample will be placed in glass bottles with Teflon caps or other specified containers such that the sampling containers are completely filled and there is no visible headspace. These bottles will then be labeled with the boring number, sample number, segment number, date collected, depth interval, and analyses requested. These soil samples will be retained in a field cooler or refrigerator at a temperature of approximately 4°C for a period of no greater than 24 hours prior to delivery to the specified laboratory. Strict chain of custody procedures will be followed in the transfer of these samples to the laboratory.

8.2 Test Pit Soil Sample Collection Handling and Transport

Test pits will typically be excavated using a backhoe. The backhoe bucket will be cleaned prior to digging the first test pit and before digging each subsequent test pit. Test pits will be excavated through the fill to the underlying natural soil for the purpose of determining the areal and vertical extent of the fill. During the excavation process, the soil will be screened using an FID or PID by holding the detector wand over each excavated bucket of soil as it is removed from the pit, but prior to being dumped. A soil sample will be collected for laboratory analysis from each bucket using a stainless steel trowel, shovel, Encore sampler, or as otherwise specified by the site-specific sampling and analyses plan. Sampling devices such as trowels will be dedicated or decontaminated between samples.

8.3 Manual Soil Sample Collection

Depending on the depth and type of samples to be collected, a variety of methods are available for sampling subsurface soils. These include (but are not limited to):

- A stainless steel trowel or scoop, which is generally limited to collection of soil of five to six inches, depending on soil types;
- A shovel, which may be used to depths of several feet, depending on soil types;
- A hand auger that may be used to collect samples at depths of up to four or five feet.

The soil will be logged for lithology, texture, weathering, color, density, moisture, and approximate depth with a description following the USDA Soil Classification System or as indicated in the site-specific sampling and analyses plan. If no sample is to be retained for chemical analysis, in the laboratory, the sample will be placed in a glass jar or plastic zip-lock bag, which will be individually labeled with the sample identification number, depth interval (which may be part of the identification number) and the date the sample was collected.

To the extent possible disposable or dedicated sampling equipment should be used, however, when this is not possible, sampling devices will be decontaminated between uses as specified in Section 5.4, or based on the site-specific sampling plan. Field sampling representatives will wear surgical or latex gloves when collecting samples and will change gloves between samples. The field representative will collect, for later examination and/or laboratory analyses, portions of the soil collected which are: 1) generally representative of the material obtained; 2) soil from the center of the material collected; or 3) the material that appears to be the most heavily impacted, depending on the purpose of the sample collection. Degree of soil impact by contaminants may be determined using a field screening device such as a PID or FID or visual appearance such as staining, depending on the contaminants expected to be present.

Samples requiring chemical analyses will be placed in glass bottles with Teflon caps or other specified containers such that the sampling bottles are completely filled and there is no visible headspace. These bottles will then be labeled with the sample identification number, depth interval, date collected, analyses requested, and the sampler's initials. The soil samples will be retained in a field cooler or refrigerator at a temperature of approximately 4°C for a period of no greater than 24 hours prior to delivery to the specified laboratory. Strict chain of custody procedures will be followed in the transfer of these samples to the laboratory.

8.4 Field Headspace Analysis

Headspace analysis of soil will be performed for each sample specified in the site-specific sampling and analyses plan. The sample will be placed in an appropriate-sized glass jar such that two-thirds of the jar is filled with the soil sample, loosely packed, and the remainder is headspace. The top of the jar then will be covered with aluminum foil secured by a rubber band around the neck of the bottle, and allowed to stand at ambient temperature in the best available temperature-controlled space (e.g., a pick-up truck cab) for 15 minutes. Alternately, the samples will all be placed in a cooler or on ice to be removed within 24 hours and allowed to equilibrate to room temperature in an indoor area for an equivalent period of time. The probe of the field survey instrument (PID or FID) will then be inserted through the aluminum foil to just above the surface of the soil. The initial reading on the field survey instrument will be noted and monitored for at least thirty seconds, with the maximum concentration then noted on the field log at the appropriate sample depth.

The use of field screening instruments such as PIDs or FIDs for volatile compounds provides a qualitative measurement of all of the volatile compounds (or gases) being measured. These measurements do not provide quantitative analyses of specific compounds. However, the

following table provides information regarding the relative responses of commonly encountered volatile constituents measured with various types of field screening instruments:

Relative Response of Field Monitoring Equipment to Selected Compounds

Species	IP (eV)	PID ($<10.2\text{eV}$)	FID ($<15.4\text{eV}$)	CGI	TLV-TWA (ppm)	PEL/REL (ppm)	STEL (ppm)
p-xylene	8.44	+ (E) ✓	+ (E)	+	100		150
o,m-xylene	8.56	+ (E) ✓	+ (E)	+	100		150
ethylbenzene	8.76	+ ✓	+ (E)	+	100		125
toluene	8.82	+ (E) ✓	+ (E)	+	100		150
1,2-dichlorobenzene	9.06	+ (E) ✓	+	+	C50		
chlorobenzene	9.07	+ (E) ✓	+	+	P10		
benzene	9.24	+ ✓	+ (E)	+		P0.1	1
tetrachloroethylene	9.32	+ (G) ✓	+ (F)	o		25	
trichloroethylene	9.45	+ (G) ✓	+ (G)	+		25	200
methyl ethyl ketone	9.54	+ (G) ✓	+ (G)	+	200		
trans- 1,2-dichloroethylene	9.64	+ (G) ✓	+	+	200		
cis- 1,2-dichloroethylene	9.65	+ (G) ✓	+	+	200		
acetone	9.69	+ (G) ✓	+ (E)	+		250	1000
1,1-dichloroethylene	9.81	+ (G) ✓	+	+		1	20
vinyl chloride	9.996	+ ✓	+ (F) ✓	+		L1	
chloroethane	10.97	o	+ (E) ✓	+	P10		
1,1,1-trichloroethane	11.00	o	+ (E) ✓	+		C350	450
1,1,2-trichloroethane	11.00	o	+	o		10	
1,2-dichloroethane	11.05	o	+ (G) ✓	+		1	2
1,1-dichloroethane	11.06	o	+	+		100	
methylene chloride	11.32	o	+ (G-E) ✓	+	50	L	
chloroform	11.42	o	+ (G) ✓	o		2	2
dichlorodifluoromethane (F12)	11.75	o	+ (F-P) ✓	o	1000		
trichlorofluoromethane (F11)	11.77	o	+ (F-P) ✓	o	C1000		
1,1,2-trichloro-1,2,2-trifluoroethane (F113)	11.99	o	+ (G) ✓	o	1000		1250
dichlorofluoromethane (F21)	12.39	o	+ (G) ✓	o	10		

IP = ionization potential

PID = photoionization detector (HNu)

FID = flame ionization detector or organic vapor analyzer (OVA)

CGI = combustible gas indicator

TLV-TWA = threshold limit value – 8 hour time-weighted average (ACGIH)

PEL/REL = permissible exposure limit (OSHA) or relative exposure limit (NIOSH), both 8 hour time-weighted averages, value listed is lowest of the two

C = ceiling value, do not exceed (no TWA)

P = proposed value

L = use of lowest reliably detectable concentration is preferable

+

o

E

G

F

P

✓

= positive response

= no response, not detectable

= excellent response (relative to methane standard)

= good response (relative to methane standard)

= fair response (relative to methane standard)

= poor response (relative to methane standard)

primary detector

9.0 GROUNDWATER SAMPLING PROTOCOL

9.1 Sampling Set-up

Before initiating on site activities, the field representative will determine specifics of well construction, including:

- inside diameter of the well casing,
- total depth of the well,
- depth to the screened portion of the well,
- screen length, and
- the material used in the construction of the well and well screen.

Before sampling, locate all of the wells on a site map and determine the order in which each well will be sampled. If water quality information is available, the sampling order should proceed from the least contaminated to the most contaminated well. Direction of anticipated groundwater flow can be used to determine sampling order where no chemical data are available. Wells upgradient of the source area should be sampled first, then proceed from wells farthest downgradient and work towards the source area.

The following list of equipment may be needed when evacuating and sampling monitoring wells:

- Sampling and Health & Safety Plans, and other site-specific documentation and information.
- Appropriate sample containers.
- Coolers and ice (or refreezable ice packs).
- Meters, probes, and standards for field measurements.
- Appropriate quality control blanks.
- Chain of custody labels, tags, and traffic report forms.
- Keys for wells, gates, doors, etc.
- Tools to assist well access; e.g., screw drivers, hammers, chisels, pipe wrenches, bolt cutters, mini-bailer or flexible cup, metal detector, or even a propane torch. Any or all of these may be necessary for removing steel security caps on wells that have not been recently opened. Also, consideration should be given for flush-mounted wells that may a) need to have water removed before breaking the seal of the well cap, b) need to have ice chipped away, or c) need to be found by a metal detector, if buried.

- Tape measure graduated in tenths and hundredths of feet.
- Electronic water level indicator/graduated depth sounder.
- Pocket calculator.
- Log book and indelible ink marker.
- Well evacuation equipment (bailer or pump). The size and capacity of the pump to be used to purge the well will depend on the inside diameter of the well casing, the depth to water, the total depth of the well, the well yield, and the volume of water to be removed. In some cases, a bailer may be necessary for well evacuation. ARM recommends the following equipment be used for well evacuation, when applicable:
 - For 2-inch diameter wells, where depth to water is greater than 25 feet: a small diameter submersible pump. In special situations, a bladder pump may be used, with special instruction.
 - For any well with an I.D. of 2-inches or greater and where the water level in the well will remain above 25 feet: a self -priming centrifugal pump. A ball valve may be necessary to adjust the pumping rate so that the level of water in the well can be maintained above 25 feet. The intake hose may also need to be fitted with a foot valve, if the depth to water is 10 feet or greater.
 - Disposable plastic tubing may be used for each well for ease of decontamination.
 - For 2-inch wells where a low volume of water needs to be purged, and when the well is likely to go dry before three well volumes are purged: a small diameter bailer. Bailers are not recommended for purging when volatile organics are the primary or only constituents of concern.
 - For larger-diameter wells (4-inches or greater), where depth to water is below 25 feet: a large-diameter, impellor-type, submersible pump. Great caution must be taken when using this type of pump, as it can be very difficult to decontaminate compared to the other types of pumps used for evacuation.
- Bottom-loading PVC, stainless steel, or Teflon bailer for sample collection.
- Decontamination solutions/water.
- Buckets, graduated plastic pails and / or low-flow totalizing meter.

- Unused plastic to stage materials and equipment, as needed at each well.
- Camera and film.

After assembling all the required sampling materials and equipment, be sure that it is in working order, and has been decontaminated.

9.2 Groundwater Sampling Procedures

Specific sampling procedures, including water level measurement, monitoring well purging, purge water containment, sample collection, documentation, and shipping are discussed in this section.

9.2.1 Monitoring Wells

9.2.1.1 Water Level Measurements

Depth to water will be measured prior to development or sampling at each groundwater sampling location. These elevation data will be used to calculate sample purging information, and may be used for other purposes. Measurements will be obtained using an electronic water level measuring device. These measurements will be taken at the designated permanent reference survey point marked on each inner well casing. Equipment used to measure these depths will be decontaminated prior to being placed in the well.

Prior to purging and sampling, the static water level will be measured using the electronic water level measurement device. This measurement shall be recorded to the nearest 0.01 feet from the designated survey point.

9.2.1.2 Monitoring Well Purging

Wells should be purged according to the procedures presented in Section 4.5, above. The intake structure of any purge device shall be positioned in a manner that allows for the removal of all stagnant water from the well. Confirmation of the removal of all stagnant water shall be accomplished by verifying the drawdown of the pump used for purging or by bailing from the top of the column.

The volume of water present in the well boring will be calculated using the following equation:

$$V = \pi r^2 h$$

Where:

V = Volume (using this equation volume should be calculated in cubic feet (ft.³) or cubic inches (in³). Be sure to use consistent units throughout the calculation;

r = radius of the I.D. of the well casing (in inches or feet);

h = height of water in the well (total depth of the well minus the static water level measurement in inches or feet).

When volume is calculated in cubic feet (ft³), cubic feet can be converted to gallons by multiplying the number of cubic feet by 7.48 (one cubic foot is equal to 7.48 U.S. gallons).

Monitoring wells will be purged using one of the following configurations or equivalent methods:

1. A non-dedicated submersible pump constructed of stainless steel and Teflon[®] components equipped with appropriate low-sorption discharge tubing.
2. A 2-inch diameter bladder pump, also referred to as a “squeeze” pump, consisting of a flexible Teflon[®] Bladder enclosed in a rigid stainless steel housing. A screen is attached to the pump to filter any material which could clog either of the check valves located above or below the bladder. The bladder pump is operated using an air compressor and an electronic cycling control mechanism (logic unit).
3. A self-priming variable-speed low-volume peristaltic pump equipped with a Teflon[®]/silicone tubing. The tubing is typically dedicated to the well.
4. A bailer constructed of either PVC, Teflon[®], PE or stainless steel.
5. Other PADEP- and USEPA-approved methods.

If any of the above equipment is dedicated, it will be stored in the well or in a dedicated storage container (PVC canisters or plastic bags) between sampling rounds. All dedicated equipment which is not stored in the well will be fully cleaned and decontaminated between sampling events in accordance with the procedures outlined above in Section 5.4.

9.2.1.3 Disposal of Purge Water

All water removed from the well during purging will be contained and disposed of properly. Site-specific conditions will determine the available means by which purge water can be handled and may include treatment and discharge or removal from the site by a licensed waste disposal/recycling company.

9.2.1.4 Sample Collection

Sampling will begin within four hours after purging has been completed. The samples will be collected in the order indicated in Table 2 below.

Table 2: Sample Collection Order	
Order	Parameter
1	Volatile Organics
2	Acid Extractable Organics
3	Base/Neutral Extractable Organics
4	Pesticides/Herbicides/PCBs
5	Metals
6	Field Parameters: pH Temperature Specific Conductance

The only exception to this requirement will occur when a sufficient volume of water for all of the required samples is not present in the well at the end of the four-hour period following purging. In that case, VOC samples will be collected immediately. Sampling for other parameters then will be delayed until the required volume is present for the remaining samples, but in no case for longer than 24 hours without repurging the well. Every effort will be made to collect samples within four hours of purging.

Layers of disposable surgical-type gloves or nitrile gloves will be used for all sampling, regardless of the level of contamination. Gloves will be changed following each activity that may contaminate them and, at a minimum, between wells.

9.2.1.5 Sampling Techniques and Methods

In all instances, to ensure that a groundwater sample is representative, physical alteration of the sample will be minimized and chemical contamination must be prevented during the sampling process. VOC samples will be transferred to sampling containers in such a way as to minimize agitation and aeration. To the extent practicable, the same type of sampling device shall be used in wells of similar constructional and yield characteristics. The following is a list of sampling equipment and techniques that may be used to collect groundwater samples at this site.

1. PVC, PE, Teflon[®] or stainless steel bailer equipped with bottom emptying devices: The bailer will be lowered slowly into the water column so as to minimize agitation of the water column. After the sample is brought to the surface, it will be emptied into the sample container using the bottom emptying device.

2. A variable-speed Teflon[®] –and-stainless –steel submersible pump as described in the Section 9.2.1.1, above: The groundwater sample will be collected directly from the discharge line of the pump with the flow rate adjusted to the slowest and most steady flow rate possible.
3. Bladder pump: The sample will be collected using the bladder portion of the two-stage pump such that the intake/discharge cycle is adjusted until as slow and steady a flow as possible is achieved as needed for sample collection.
4. Other PADEP- and EPA-approved methods may be used as described in the site-specific sampling and analyses plan.

9.2.2 Residential and Municipal Wells

Some precautions must be taken when collecting ground water samples from residential and municipal wells. Proper scheduling of sampling periods for residential and municipal wells is important. It is important that a municipal well be sampled while it is in a pumping cycle; thus ensuring that you are taking a sample from water that has not been held stagnant in the well casing.

When collecting a sample from a residential well it is necessary to purge all stagnant water from the well casing and pressure tank prior to sample collection. This should be done by determining the volume of water in the well casing and the volume of the pressure tank. However, information regarding the depth and/or diameter of the well is frequently difficult, if not impossible to obtain. In the absence of this information, water should be discharged from the proposed sampling faucet/spigot and as many other faucets as possible, thus purging water from the holding tank and well. The sampler should note when the well pump turns on, indicating that the water level in the holding tank is low and the pump is drawing water from the well. As a best estimate, in lieu of specific well information, it is generally safe to proceed with sampling 20 minutes after the pump has turned on. Water quality samples are to be collected from the spigot or faucet closest to the well, preferably before the water enters the pressure tank or treatment system. Water should be collected from an unscreened faucet or spigot, which is most frequently accomplished by sampling an outside spigot.

When sampling for bacterial analyses, the outside of the faucet or spigot should be disinfected with isopropyl rubbing alcohol or by heating the spigot with a flame to ensure that bacteria on the spigot, but not in the water itself, do not contaminate the sample.

Contact the owners or operators of the wells to determine what tools, valves, hoses, etc., will be needed. Wrenches may be needed for opening and closing faucets or spigots. Often spigots on municipal wells may be too large, resulting in a high-volume flow which will make sampling difficult. In this case, it will be necessary to reduce the flow by using appropriate fittings. Obtain information from the operator on the size of the fittings required and on accessibility of the sampling spigot. It may be convenient to

attach a section of inert plastic (such as Teflon[®]) -tubing to the spigot, especially under very cramped quarters.

Generally, all the equipment listed in the previous section on ground water sampling for monitoring wells should be used during the sampling of residential and municipal well with the exception of the pumps and the bailer. Since municipal wells are high volume water producers, there is no necessity for evacuating the well. However, the lines between the well and the spigot must be cleared. For most residential and municipal wells, the samples can be collected either directly into the sample bottles or, in cases where sample filtration is needed, samples can be placed directly into the filtration apparatus.

When collecting treated water samples from residential or municipal systems with, a post-treatment tap must to be cleared of stagnant water. Sample collection can then proceed, usually directly into the sample container. If samples are to be collected from before, between and after the filters, start with the cleanest water (after the filter(s)), and proceed to the least clean (before any filter(s)). As with the ground water samples collected from monitoring wells, it will be necessary to prepare and preserve the samples prior to storage.

10.0 SURFACE WATER SAMPLING PROTOCOL

Surface water sampling may include the sampling of streams, rivers, ponds, or lakes. Prior to sampling, the surface water drainage in and around the area to be studied should be characterized using all available background information, including topographic maps and aerial photographs. As with all sampling procedures, an initial survey of the site should be conducted to verify sampling locations. This site survey will help to identify any special equipment, personnel safety requirements, or procedures which might be necessary due to terrain or other factors specific to the site. Needed background information includes: the depth of the surface water body, flow rate, and overall position of the sampling point and/or stream or tributary in the stream basin. Also, it is recommended that stream characteristics, such as stagnation zones or mixing zones which might affect the distribution or volatilization of constituents in the water, be noted.

10.1 Preparation for Sampling

The equipment needed for most surface water sampling is minimal. In fact, in many instances, the sample container will serve as the sampling device. The following is a recommended list of surface water sampling equipment and accessories:

- Sampling and Health & Safety Plans, and other site-specific documentation and information.
- Appropriate sample containers, meters, probes, and standards for in situ measurements.

- Appropriate quality control blanks. The type and number of blanks should be established with the project manager.
- Chain-of-custody labels, tags, and record forms.
- Flow and velocity estimation devices.
- Sampling devices. These may include anything from use of the sample containers to use of a telescoping aluminum pole with an attached beaker known as a grab sampler. Otherwise, a Kemmerer sampler can be used to collect samples from a particular depth in the water column. Because of the problems that may result from the inaccessible nature of many surface sampling locations, it may be appropriate to use a boat to sample surface waters.
- Decontamination solutions/water. These will be used for decontaminating all equipment that comes into contact with the sample.
- Buckets, plastic wash basins, scrub brushes, and sponges. These will be used for cleaning contraindicated equipment and materials.
- Camera/film. For use in documenting sampling procedure and sample location.

10.2 Sample Collection

Most surface water samples are taken as grab samples. Typically, surface water sampling involves immersing the sample container in the body of water. The following suggestions are made to help ensure that the samples obtained are representative of the body of water being sampled:

- Generally, the most representative samples of streams or rivers are obtained at mid-channel, at one-half of the stream depth.
- Stagnated areas in streams or rivers might contain zones of contaminant concentration, depending upon the physical/chemical properties of the contaminants and the position of these stagnated waters relative to the source of contamination.
- When sampling a stream, proceed from downstream to upstream stations to avoid releasing contaminants into the water from bottom sediments.
- Though the containers used to obtain the samples are previously cleaned in the laboratory, it is recommended that the sample container be rinsed at least once, preferably three times with the water to be sampled before the sample is taken. Fill preserved sample containers using one that was not preserved. Do not collect surface water samples directly into preserved containers.

- Sampling must begin at the suspected zones of lowest contamination and proceed towards to the zones of highest contamination (except in the case of streams).
- When sampling a pond or other large standing body of water, the surface area may be divided into grids. A series of samples may be taken from each grid and combined into one sample (a composite) or separate samples may be obtained from several grid locations at random. This will improve the representativeness of the sample and/or samples.
- A composite sampler may be used to collect a composite sample at a specific location over time or proportional to flow.
- Care should be taken to avoid excessive agitation of the water, which can result in the loss of volatile constituents. In this regard, samples cannot be composited for VOC analysis.
- Do not take a surface water sample at the surface/water interface unless sampling specifically for a known constituent, which is immiscible with water (i.e., such as oil which floats on top of water). Instead, the sample collection device should be inverted, lowered to one-half the water depth and held at about a 45 degree angle with the mouth of the bottle facing upstream.

Specific sampling procedures should be followed when collecting surface water samples for the analyses of VOCs. These procedures are described as follows:

- VOC samples are to be collected in 40-ml vials,
- Vials are to be filled by slowly submerging the vials in the water and allowing the bottle to fill with a minimum of turbulence,
- During sampling the vial is to be submerged at an angle and slowly righted as it is filled,
- As the vial is lifted from the water a proper meniscus is to remain at the surface of the water sample and the Teflon septum cap is to be screwed on slowly,
- Finally, the sample should be checked for the presence of undesired air bubbles by turning the vial upside down and tapping the outside of the vial with one's finger to determine whether air bubbles float to the upside of the vial.
- If any bubbles are visible, a new sample will be collected using the aforementioned procedure.
- The vials will be held using gloved hands (latex or vinyl surgical type) with the sampler standing on the stream bank or downstream from the point where the vial is to be filled to minimize the possibility of contamination.

Generally, surface water samples are more stable than ground water samples because these waters tend to be in equilibrium with atmospheric conditions. Therefore, samples from surface waters will not undergo significant changes in water chemistry upon extraction from their environment. However, it is still important to prepare, preserve, store and perform all in situ measurements on the samples immediately after sample collection. Additionally, it is important that each vial be labeled after sample collection to minimize potential contamination of the sample by the label adhesive or labeling pen.

11.0 SEDIMENT SAMPLING

The collection of sediment samples from ponds, lagoons, or streams is normally not a difficult task unless sampling is being conducted at great depth in which case a boat and specialized equipment would be necessary. Caution must be taken to obtain samples that will be representative of the contaminants of interest versus the sediment materials present. For example, it is unlikely that absorbed organic constituents will be found in high concentrations in coarse-sized materials. However, the finer materials which are most likely to adsorb organic contaminants from stream waters may not be located within the immediate flow areas of the stream transporting the contaminants, rather they would be located in less turbulent areas.

11.1 Preparation for Sampling

A review of site background information may give an indication of the type of constituents present in the sediments and the type of sediments to be collected. It is important to consider the following:

- Constituents that may have affinities for particular sediment types.
- Hydrogeological information which may help establish a relationship between the contaminant source and the contaminants in the sediment;
- The pH of the surface water over the sediments. Unusual pH conditions may influence contaminant precipitation.
- Several sediment samples should be obtained from the area nearest the suspected contaminant point source. These samples should also be collected from various types of materials near the source (i.e., coarse gravels versus fine clays) to determine the relationship of the contaminants to the sediment material.
- Samples should be collected progressing from downstream to upstream to prevent the release of potentially contaminated sediments from one sampling station to another further downstream.

11.2 Sample Collection

When developing a sampling plan for the collection of sediments from small streams or surface drainageways, it is important to address possible effects of run-off, which may have occurred many years prior to the time of the sampling. Consequently, it is often insufficient to test only the surface sediments because erosion and deposition of additional stream bed sediments in the intervening years could have formed a cover of uncontaminated surface sediments over potentially contaminated sediments.

Therefore, the following procedures are recommended for the collection of samples from small streams:

- Assess which side of the stream received contaminated sediments from overland flow and collect samples on that side of the stream from mid-stream to the stream bank.
- Using a shovel, trowel, core, or bucket sampler, collect a surface grab or composite sample of the top six inches of sediment.
- At these same locations, collect another grab or composite sample at an approximate depth of six to twelve inches.
- When collecting composite samples, the number of samples collected at each location should be proportionate to the stream width (i.e., three samples from a six-foot wide stream should be sufficient to characterize sediment quality).

Comparatively, when sampling from large rivers, ponds, or lakes, it may be necessary to lay out a visual or surveyed grid, if possible, and composite samples or collect grab samples from either random or regular locations within the grid.

After determining the relationship between the contaminant constituents and the sediments, a sampling plan can be prepared. The following list of recommended sediment sampling equipment:

- Sampling and Health & Safety Plan, and other site-specific documentation and information.
- Appropriate sample containers.
- Log book and indelible ink marker.
- Sampling devices. These may range from the sample container and trowel, to more elaborate, power-driven devices. See discussion below on sediment sampling techniques.
- Decontamination solutions/water.
- Buckets, wash basins, scrub brushes, and sponges.

- Camera/film.

Very simple techniques can usually be employed in collecting sediment samples. Below are some suggested techniques for sediment sampling:

- As previously mentioned, in small, low-flowing streams or near the shore of a pond or lake, the sample container, a shovel, or hand-operated bucket auger may be used to scrape up sediments. The sediment must be dewatered as much as possible so as not to reflect soluble concentrations in the water.
- To obtain sediments from larger streams or further from the shore of a pond or lake, a beaker attached to a telescoping aluminum pole by means of a clamp may be used to dredge sediments.
- To obtain sediments from rivers or in deeper lakes and ponds, a spring-loaded sediment dredge (Eckman dredge) or benthic sampler may be used. Several types of sediment core samplers exist for specialized sampling of sediments.

Lastly, all the equipment used should be decontaminated between the sampling stations using the procedures described previously.

12.0 POST SAMPLE COLLECTION HANDLING

12.1 Sample Storage

In the field, samples will be kept in a cooler with ice until the samples can be refrigerated or received at the laboratory. Refrigerated samples will be kept below 4°C.

For shipping, all sample containers must be placed in a strong shipping container, such as a plastic or metal insulated cooler. The following are some procedures that will help ensure correct shipping:

- Tape the drain plug closed with shipping tape to ensure that water does not drain out of the cooler.
- Line the bottom of the cooler with vermiculite (or other padding/absorbent) sufficient to absorb and potential spillage.
- Check screw caps for tightness and place each container in individual zip-lock plastic bags, before placing sample containers in cooler,
- Place vermiculite, peanuts, shipping air-filled bags, or other clean, dry materials between containers to prevent container breakage.

- Place ice sealed in plastic bags or cool packs to maintain 4°C in the cooler.
- Fill remaining space with vermiculite, peanuts, shipping air-filled bags, or other clean, dry materials to ensure no movement or “clanging” of the containers when the cooler is shaken.
- Seal chain-of-custody documents in a zip-lock plastic bag and tape to the inside of the cooler lid.
- Close and fasten the lid of the cooler.
- Affix a custody seal/tape to the cooler so that any potential tampering can be detected.
- Attach the following to the outside of the cooler:
 - Name and address of the receiving laboratory
 - Return address
 - This End Up” label on top of the lid.

Samples packaged in this way may be shipped by commercial air. Personnel should be prepared to open and reseal the cooler for inspection if it is required. Be aware that some commercial carriers have limits as to the number of pounds per item that can be shipped. Materials other than environmental samples must be shipped per US DOT regulations.

12.2 Sample Shipment

Samples will be hand-delivered to the laboratory, picked up by the laboratory, or shipped via a commercial priority overnight delivery service. In cases where samples leave the immediate control of the sampling team, (i.e. shipment via overnight delivery service), the shipping container (cooler) must be sealed to ensure that the samples have not been disturbed during transport. Custody seals are not required on coolers when the samples in the coolers remain in the possession of the field crew or the field crew’s designee at all times prior to arrival at the laboratory.

13.0 DOCUMENTATION AND CHAIN OF CUSTODY

All field documentation will be the responsibility of the designated sample technicians or ARM field representatives who collect the samples. These documents will be reviewed by the project manager for completeness and accuracy.

13.1 Field Data Sheets

The documentation of sample collection includes the use of bound field log books or field data sheets designed specifically for particular types of sampling. All information on sample

collection must be entered into log books or field data sheets in indelible ink. Appropriate information must be entered to reconstruct the sampling event, including the following:

- Site name (top of each page)
- Sample identification
- Brief description of sample
- Date and time of collection
- Sampling methodology
- Field measurements and observations
- Sampler's initials (bottom of each page, and dated)

ARM's Sampling Notebook SOP should be photocopied and attached to the front cover of all field books used. This will help ensure that all required information is recorded. The Sampling Notebook SOP is shown below:

Sampling Logbook SOP

All entries in the log book must be made in ink.

First page should contain the following:

- Site name and number
- Date and time started
- Personnel on site

Each new day should contain:

- Date and time started
- Weather
- Personnel on site – including any non-ARM personnel
- Sampling information (see Sample Information next page)

When a mistake is made in the Log, put a single line through it in ink and initial and date

Sample Information

- Sample #
- Date and time Sample Collected
- Source of Sample (well, stream, domestic well, field, etc.)
- Purged Well – type of equipment, purge volume, rate of purge, recovery period, and decontamination procedures
- Location of sample – document with a site sketch and/or written description, where sample was taken so that it could be found again
- Method of collection (bailer, trowel, split spoon, thief, etc.)
- Analysis and QA/QC required (Method 601, 602; Metals; Tier I, Tier II; etc.)
- Chemical preservation used (HNO_3 , H_2SO_4 , NaOH , etc.)
- Field Data (pH, DO, Sp.C., Temp, etc.)
- Field Observation – significant observation should be documented.
 - Sample condition (color, odor, turbidity, oil, sheen)
 - Site condition (stressed vegetation, exposure of buried wastes, erosion problems, etc.)
- Comments – Any observation or event that occurred that would be relevant to the site; for example, weather changes or effect it had on sampling, conversations with client, public official or private citizen; instrument calibration, equipment problems, etc.

Field data sheets shall also be completed at the time of purging and sampling of each well, and for all soil, sediment, surface water, and QA samples. Every blank on the field data sheet must be filled in. Example field data sheets are presented in Attachment 1.

13.2 Chain-of-Custody

Signed chain-of-custody forms shall accompany all samples to the laboratory and remain with the samples at all times until the samples arrive at the laboratory. Chain-of-custody documentation allows for the tracking of possession and handling of individual samples from the time of field collection through laboratory analysis. The chain-of-custody record will, at a minimum, contain the following information:

- unique sample identification number,
- analyses requested,
- name of sample custodian,
- date and time of collection,
- date and time of sample receipt in laboratory,
- temperature of temperature blank in sample container,
- signature of person(s) relinquishing/receiving samples, and
- requested turn-around time.

Any information relating to condition of samples upon receipt shall be written on the Chain-of-custody form as a comment.

ATTACHMENT 1

STANDARD FIELD DATA FORMS

BORING LOG

Client:

ARM Project No:

Project Description:

Site Location:

ARM Representative:

Checked by:

Drilling Co.

Driller

Drilling Eq.

Casing Type

Casing Dia

Sheet 1 of 1

0 hr Depth to GW

24 hr Depth to GW

Date Started

Date Completed

Weather

Elevation (ft.)	Depth (ft.)	Sample			Description (USCS)	Graphical Symbol	Well Construction	Remarks
		Number	Blows per 0.5 ft.	Type				
	0				Ground Surface			
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18				End of Borehole			
	19							
	20							

ARM Group Inc.
1129 West Governor Road, Box 797
Hershey, Pennsylvania 17033-0797
(717)533-8600 FAX: (717)533-8605
EARTH RESOURCE ENGINEERS AND CONSULTANTS



MACROCORE LOG

Client:

ARM Project No:

Project Description:

Site Location:

ARM Representative:

Checked by:

Drilling Co.:

Operator:

Drilling Eq.:

Sampler Type:

Sampler Dia:

Sheet: 1 of 1

0 hr Depth to GW:

24 hr Depth to GW:

Date Started:

Date Completed:

Weather:

Elevation (ft.)	Depth (ft.)	Sample			Description (USCS)	Graphical Symbol	Pocket Penetrometer (tsf)	Remarks
		Number	Recovery	Sampled				
0	0				Ground Surface			
-1	1							
-2	2							
-3	3							
-4	4							
-5	5							
-6	6							
-7	7							
-8	8							
-9	9							
-10	10				End of Boring			
-11	11							
-12	12							

ARM Group Inc.
1129 West Governor Road; P.O. Box 797
Hershey, Pennsylvania 17033-0797
(717)533-8600 FAX: (717)533-8605
EARTH RESOURCE ENGINEERS AND CONSULTANTS



GROUNDWATER SAMPLING RECORD SHEET

Sheet Number _____ of _____

Job Name: _____ Job Location: _____
 Job Number: _____ Phase: _____ Task: _____
 Sample Location: _____ Name(s) of Sampler(s): _____
 Description of Sample: Water _____ Soil _____ Other _____

PURGING

Time/Date Started: _____
 Air Temperature: _____ (°F/°C)
 Weather Sunny _____ Rain _____
 Conditions Overcast _____ Other _____
 Depth to Water: _____ ft
 Total Well Depth: _____ ft
 Height of Water Column: _____ ft
 Well Diameter: 1-inch _____ 4-inch _____
 2-inch _____ 6-inch _____
 Well Volume Calculation:
 _____ ft x _____ gal/ft = _____ gal
 Purge Volume = _____ x _____ = _____ gal
 Purging Method: Pump _____ Bailed _____ Other _____
 Gallons Removed: _____ gal
 Length of Time Purged _____ min
 Yield at End of Purging: _____ gpm
 How was yield measured? _____
 Color _____ Odor _____
 Turbidity _____
 Was well cavitating? Yes _____ No _____

SAMPLING

Time/Date Started: _____
 Air Temperature: _____ (°F/°C)
 Weather Sunny _____ Rain _____
 Conditions Overcast _____ Other _____
 Depth to Water: _____ ft
 Sampling Method: Bailer _____
 Submersible Pump _____
 Peristaltic Pump _____
 Other _____
 Number of Bottles Filled: _____
 Date Sent To Lab: _____
 Laboratory Name: _____
 Parameters to Analyze: _____

 Chain of Custody Number: _____
 Other: _____

FIELD DATA

Time		Remarks: _____
Volume of water purged	gal	_____
pH	s.u.	_____
Conductance	umhos/cm	_____
Temperature	°F/°C	_____
DO	mg/l	_____
Redox	mV	_____
OVA, TIP, HNU	ppm	_____
Color -		_____

Pipe Volume:

1" I.D. = 0.041 gal/ft
 2" I.D. = 0.163 gal/ft

4" I.D. = 0.653 gal/ft
 6" I.D. = 1.47 gal/ft



CHAIN OF CUSTODY/
REQUEST FOR ANALYSIS

Please print. See back of COC for directions

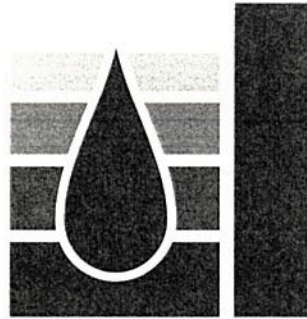
COC #:

Sample Date:

Client Name:		ANALYSES REQUESTED										RECEIVING INFO (Lab use only)	
Address:												COOLER TEMP:	
Contact:												COC SEAL INTACT: Y or N	
Phone #:												SHIPPING CARRIER:	
Project Name/#:												SHIPPING NO:	
Quote/PO #:													
TAT: Normal <input type="checkbox"/> *Rush <input type="checkbox"/> *Rush TAT subject to approval and surcharges													
Date Required:													
Approved by:												Container Type	
Fax Results ? Y or N #:												Preservative	
SAMPLE DESCRIPTION/LOCATION		GC		TIME		MATRIX		NO OF CONTAINERS PER ANALYSIS REQUESTED				COMMENTS/FIELD DATA	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
Print Name and Company		Signature		Date/Time		Remarks:							
Sampled by:													
Received by:													
Relinquished by:													
Received by:													
Relinquished by:													
Received by:													
* G = Grab; C = Composite		* Matrix		SO = Soil; SD = Solid; DW = Drinking Water; WW = Wastewater; GW = Groundwater; SL = Sludge; OL = Oil									
METHOD PROTOCOL:		SW846 <input type="checkbox"/>		CFR136 <input type="checkbox"/>									
DRINKING WATER <input type="checkbox"/>		OTHER:											
REPORTING REQUIREMENTS:		PADEP <input type="checkbox"/>											
OTHER:		PWSID:											

APPENDIX B

**GLA LABORATORY QUALIFICATIONS
PACKAGE**



GLA LABORATORIES
STATEMENT OF QUALIFICATIONS

1.0 INTRODUCTION

GLA is a full service environmental testing laboratory located 15 miles northwest of Philadelphia, Pennsylvania. The facility is located in King of Prussia, Pennsylvania just minutes from Routes 202, 422, 76, 476, and the Pennsylvania Turnpike. The Laboratory was opened in 1994 to provide exemplary laboratory services to clients throughout the region. Currently, GLA Laboratories has compiled a large client base comprised of industry, government agencies, remediation contractors, engineering firms, environmental consultants and private parties.

GLA Laboratories is owned by Great Lakes Analytical Corporation. Great Lakes Analytical operates a full service environmental laboratory in Buffalo Grove, Illinois. GLA, as well as Great Lakes Analytical, is part of the Sequoia Laboratory Network. The Sequoia Network is currently the third largest laboratory network in the United States and operates 21 laboratories nationwide. The Sequoia Network also operates two laboratories internationally. Whether your project is in the Midwest, West Coast, or one of the many other regions served by the Sequoia Network, our laboratory can meet your analytical needs.

GLA is committed to providing the highest level of customer service. We understand that meeting the turnaround time commitment we make to our clients, is central to the overall success of their projects. One example of our commitment to excellent customer service is our standard five working day turnaround time. We also offer expedited turnaround times as short as a few hours for certain tests. Our success rate in meeting the turnaround time commitments made to our clients is greater than 95 percent. Another service element we provide is free sample pickup and bottlewear delivery. Depending on your location, this service is provided by either a GLA courier or reputable overnight mail system (e.g., Federal Express or UPS).

GLA is committed to providing customer service and technical support in a personal manner. Whenever you call GLA during normal business hours (8:00 a.m. to 6:00 p.m.), the Laboratory Director and Quality Assurance Officer are available to answer your questions.

GLA is a full-service environmental laboratory experienced in the analysis of air, soil, water, and solid waste. Our capabilities include: metals; wet chemistry; pesticides; PCBs; TCLP/SPLP; volatile organics; and semi-volatile organics. These analytical services are our only business; we do not compete with our clients in any way.

GLA Laboratories is a state-of-the-art custom designed facility. Our laboratory is fully equipped with state-of-the-art instrumentation and offer a great deal of redundancy to insure client turnaround commitments are met. Our equipment is constantly being updated to stay current with the latest technology. Any current or perspective client is welcome to visit our laboratory.

The quality of the measurements we make is the foundation on which our business is built. Understanding this, we place great emphasis on quality control in the operation of our laboratory. One of the most critical elements of our program is our Corporate Quality Assurance Quality Control (QA/QC) Manager. With no operational responsibilities, the QA/QC Manager is able to focus on insuring that our Quality Assurance Program is running smoothly. Our Quality Assurance Program is a vigorous program that meets or exceeds the requirements of the U.S. EPA and our certifying state agencies.

2.0 SUMMARY OF EXPERIENCE

GLA Laboratories has participated in thousands of investigations, remediations and monitoring projects since it began operation in 1994. Our current client list includes over 200 organizations. Included in this group are local, state and Federal agencies, engineering firms, environmental consulting firms, industries, financial institutions, private individuals, and military service branches.

Our laboratory receives over 2,000 samples of air, water, soil and solid waste each month. Our staff performs thousands of measurements on these samples. Our turnaround time options range from our standard turnaround time of five working days to 24-hour service. Shorter turnaround times, of as little as a few hours, are available in some cases. Laboratory services on weekends and holidays are also available with advance notice.

Our standard data package includes all the information necessary to meet the requirements of characterization, remediation, and monitoring projects, as well as regulatory requirements. Our standard data package include the sample data sheets and chain of custody. In addition, we offer five standard deliverable packages are described below:

- Level A -** It includes sample data summary sheets in addition to LCS, Surrogate and MS/MSD recoveries. Method blank data is included.
- Level B -** This package contains the Level A data plus CLP data flags, and a case narrative.
- Level C -** This package contains the Level A and B data, plus instrument and extraction blank results, and initial calibration data.
- Level D -** This package contains all the information above in addition to all raw data. The raw data includes all sample and QC chromatograms, tuning criteria, extraction, digestion and run logs, and all other instrument printouts. Upon request, this data is formatted to conform to New Jersey reduced deliverable packages.
- Level E -** This package consists of a full CLP data package using standard CLP forms.

Custom packages and New Jersey reduced deliverable data packages are also available.

3.0 CERTIFICATIONS

One indication of the quality of our laboratory is the certifications we maintain. While no one certification guarantees the quality of a laboratory, every audit and certification process a laboratory goes through results in improvements in the quality systems in place in the laboratory. Since GLA began operations in 1994, it has undergone numerous audits by both industry, engineering and consulting firms, and state regulatory agencies. A list of the subject state regulatory agencies include: Pennsylvania, Delaware, New Jersey, New York, Maryland, and West Virginia. GLA has also been audited and granted accreditation through the New York State National Environmental Laboratory Accreditation Program (NELAP). A copy of these and other on-site audit reports are available upon request.

Many states require that laboratories be certified in order to perform compliance related analysis in their state. These requirements vary from state to state as well as from program to program within a single state. Our membership in the Sequoia Laboratory Network will allow our Project Manager at GLA to coordinate your laboratory services when performing work in most areas of

the country. If you are unsure about the certification requirements of a particular state or program, contact your Project Manager at GLA for assistance.

GLA maintains the following certifications:

- Delaware Health and Human Services, Drinking Water Laboratory Certificate Number PA 915.
- Maryland Department of Health and Mental Hygiene, Water Quality Laboratory ID Number 253.
- New Jersey Department of Environmental Protection, Waste and Drinking Water, Laboratory Certification Number 77004.
- New York State Department of Health, Non-Potable Water and Solid and Hazardous Waste, Laboratory Certification Number 11593.
- Pennsylvania Department of Environmental Protection, Certified Drinking Water Laboratory, Laboratory ID Number 46-505.
- West Virginia Division of Environmental Protection Office of Water Resources, Drinking Water, Laboratory ID Number 226.
- New York National Environmental Laboratory Accreditation Program, NY Laboratory ID Number 11593; EPA Code PA00918.

Copies of our certificates can be found in *Appendix I*. A list of the Sequoia Network Laboratory locations and related certifications can be found in *Appendix II*. Our Certificates of Insurance can be found in *Appendix III*.

4.0 EQUIPMENT AND FACILITIES

GLA's laboratory occupies an 8,000-square foot custom designed facility. GLA is constantly upgrading its instrumentation capabilities. Major equipment and instruments include:

4.1 Organic Analytical Instrumentation

4.1.1 Gas Chromatograph/Mass Spectrometers (GC/MS)

GC/MS-1

Hewlett-Packard 5972 Mass Selective Detector
Hewlett-Packard 5890 Series II Plus Gas Chromatograph
RTX-502.2 60M X 0.53 mm Column
Tekmar LSC 3000 Purge and Trap
Varian Archon Autosampler
MS-DOS Enviroquant Data Management System

GC/MS-2

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
DB-5MS Column
Hewlett-Packard 7673A Autosampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-3

Hewlett-Packard 5971 Mass Selective Detector
Hewlett-Packard 5890A Gas Chromatograph
RTX-502.2 60 M X 0.53 mm Column
Tekmar LSC 3000 Purge and Trap
Varian Anchon Autosampler
MS DOS Enviroquant Data Management System

GC/MS-4

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
J&W DB5MS 0.25 mm X 30M Column for EPA 8270
Hewlett-Packard 7673A Autosampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-5

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
Restek RTX – 502.2 40M 0.18 mm Column for EPA Method 8260
Tekmar LSC 3000 Purge and Trap
Varian Archon Purge and Trap Autosampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-6

Hewlett-Packard 5972 Mass Selective Detector
Hewlett-Packard 5890 Series II Plus Gas Chromatograph
RTX-502.2 60M X 0.53 mm Column
Tekmar LSC 3000 Purge and Trap
Varian Archon Autosampler
MS-DOS Enviroquant Data Management System

4.1.2 Chromatography

GC-1

Hewlett-Packard 5890 Gas Chromatograph
J&W DB5 30 X 0.25 mm, and DB17 30 M X 0.25 mm Column
ECD/ECD Detectors
Hewlett-Packard 7673A Autosampler
MS-DOS Enviroquant Instrumentation Control Software

GC-2

Hewlett-Packard 5890 Gas Chromatograph
Uses J&W DB5 30 M X Column for EPA 8015 DRO
FID Detector
MS-DOS Enviroquant Data Management System
Hewlett-Packard 7673A Autosampler

GC-3

Hewlett-Packard 5890 Gas Chromatograph
Restek 502.2 0.53 mm X 60 M Column
FID/PID Detectors
Tekmar LSC 2000 Purge and Trap
Tekmar ALS 2032 Autosampler
INS-DOS Enviroquant Data Management System

GC-4

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB17 30M X 0.25 mm and DB5 0.25 mm X 30 M Columns for Methods 8081, 8082
ECD/ECD Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
(2) Hewlett-Packard 7673A Autosampler

GC-5

Hewlett-Packard 5890 Gas Chromatograph
J&W DB5 30 X 0.25 mm, and DB17 30 M X 0.25 mm Column
ECD/ECD Detectors
Hewlett-Packard 7673A Autosampler
MS-DOS Enviroquant Instrumentation Control Software

4.2 Inorganic Analytical Instrumentation

4.2.1 Trace Metal Analytical Instrumentation (AA and ICP)

- (1) Varian SpectrAA-20 Atomic Absorption Spectrophotometer
Varian VGA 76 Hydride Generator
- (1) Varian SpectrAA-400 Atomic Absorption Spectrophotometer
Zeeman Graphite Tube Atomizer
Varian 130286 Software
Varian PSD97Z Programmable Sampling System
IBM PS2 30286 Data System

- (1) Thermal Jarrel Ash AS300 Autosampler
Thermal Jarrel Ash ThermoSpec Data Acquisition System
Thermal Jarrel Ash 61E ICP

4.2.2 General Chemistry Analytical Instrumentation

Spectronic 20 UV/Visible Spectrophotometer
Sartorius AC210P Analytical Balance
Corning 340 pH/Ion Meter
O'Haus C305-5 Top Loading Balance
Cleveland Open and Closed Cup Flash Point Tester
Foxboro Miran 1A CVF IR Spectrometer
Fisher 925 pH/Ion Meter
Fisher Isotemp Oven (5)
Thermolyne 1400 Muffle Furnace
Orbeco-Hellige Turbidimeter
Hanna HI 9033 Conductivity Meter
YSI 50B DO Meter
Lachat Quikchem AE Automated Ion Analyzer
Precision Scientific 815 Low Temperature Incubator
Orbeco Hellige Turbidimeter
Milton Roy Spectronic 301 Spectrometer
Barnstead E-Pure Water Purification System
Sartorius LC6200S Top Loading Balance
Sartorius PT-600 Top Loading Balances (2)
Ohaus CT600S Top Loading Balance

4.3 Sample Preparation

Hach COD Reactor
Thermolyne 2200 Hot Plate (2)
Six-foot Fume Hood (5)
Heating System/Ultrasonics XL Sonicator (2)
Precision Water Bath (2)
Baxter Ultrasonic Water Bath
Organomation OA-SYS N-Evap

Environmental Express 12 Place TCLP Rotator
Millipore 4 Place TCLP Rotator
Millipore Haswaste Filter (2)
Heraeus Megafuge 1.0
Dade Multi-tube Vortexer
Q-Wave 3000 Questron Microwave Digestion System
Environmental Express Hot Block Digester (2)
Activated Charcoal Positive Pressure Hood (1)
Environmental Express SPE Extraction System

4.4 Field Sampling Equipment

ISCO 2910 Composite Sampler

4.5 Sample Storage

Refrigerated Storage: Approximately 600 cubic feet in five separate, lockable, and temperature-monitored refrigerators.

Unrefrigerated Sample Storage: Approximately 600 square feet of shelving for sample storage.

5.0 LABORATORY PERSONNEL

GLA Laboratories employs a staff of 40 chemists, technicians, and administrative personnel. All personnel employed at GLA Laboratories possess at least a Bachelor's Degree; which, in most cases, is in Chemistry from an ACS accredited program. It is GLA's policy never to employ the use of college interns to perform any analytical functions within the laboratory. To stay current with new analytical technology and changes in regulations, our staff attends numerous seminars and conferences put on by professional organizations and vendors. Training files are maintained for all technical employees. These files are available during any laboratory audits.

Our President, Kevin Keeley, has over 18 years of laboratory management experience. This experience includes seven years as Laboratory Director and President of Great Lakes Analytical Corporation and two years as Vice President of Laboratory Operations at Sequoia Analytical, our 40,000 square foot sister laboratory in Redwood City, California. Mr. Keeley graduated in 1984 with a B.A. in Chemistry from the University of Michigan.

Crystal Pollock, the Vice President and Laboratory Director for GLA, has over 15 years of laboratory management experience. Her experience includes five years as the Laboratory Director for GLA Laboratories and Great Lakes Analytical. Ms. Pollock has served as the Vice President for Great Lakes Analytical Corporation for three years. Ms. Pollock graduated from Iowa State University in 1988 with a B.S. in Biology. The resumes of Mr. Keeley, Ms. Pollock and key members of the staff at GLA can be found in *Appendix IV*.

6.0 QUALITY ASSURANCE SUMMARY

Our QA program is designed to insure the integrity of analytical results, in accordance with guidelines established by the EPA and various state agencies. The following summarizes our QA system. A copy of our detailed Quality Assurance Program is included as *Appendix V*.

6.1 Sample Containers

Containers are purchased from commercial sources and are equivalent to those listed in 40 CFR Part 136.

Preservatives are prepared and added to the bottles in a designated area, clearly marked, and stored in an organized manner. Bottles for all analysis are purchased only from suppliers who certify that containers were cleaned using EPA protocols.

Sample containers are provided free of charge, upon request. Advice is also available regarding sampling procedures, necessary preservatives, and sample transport considerations.

6.2 Chain of Custody

The chain of custody is the documented history of any sample. All samples received by GLA must be accompanied by a chain of custody, or one will be provided at log-in.

Sample Control personnel check to insure that all samples listed on the chain of custody are, in fact, present and in satisfactory condition.

6.3 Sample Control

Samples received by the laboratory are immediately brought to the designated sample log-in area. Sample information, including analyses to be performed, is recorded into a master logbook. The samples are then entered into our Laboratory Information Management System (LIMS).

The Sample Control Technician has the following responsibilities:

- Determine if there is sufficient quantity of sample.
- The temperature of each sample is measured using a Dickson IR550 Temperature Meter. The temperature is measured to insure the sample temperature is at or below 4 degrees centigrade.
- Determine that the holding time for the requested tests has not been exceeded. Samples received with little holding time remaining will be expedited at the expense of the client.
- Perform additional preservation as required, including splitting of samples into appropriate containers.
- Assign a unique sample number to each sample. The sample number is marked on the sample container and on the laboratory worksheet for the sample.

Store the samples in one of several refrigerators for the particular type of analysis required.

Each analyst is aware of and responsible for meeting holding time requirements. Following each analysis, samples are stored for six weeks in case follow-up or confirmatory analysis is requested by the client.

Samples determined to be hazardous may, in some cases, be returned to the client. The chain of custody is continued or a release form is signed by the client.

6.4 Maintenance and Calibration of Instruments

Major instruments are professionally serviced whenever it is deemed necessary, and in any case, at least once a year. Maintenance records are kept in a bound notebook.

All instruments are calibrated using at least three standards, and a permanent calibration record is kept. Thereafter, daily standards are run and should generally read within 5 to 15 percent of the

calibration curve depending on the analytical method. Some analytical methods require daily calibration for each analyte to be tested.

6.5 Quality Control Protocol

The Laboratory Director is responsible for all aspects of the QA Program. The Corporate QA Manager assists the Laboratory Director by monitoring compliance with the QA Program through semi-annual performance audits of each analyst. The findings of these audits are communicated to the President and Laboratory Director. The Laboratory Director is responsible for the day-to-day implementation of the QA Program.

Quality control checks at the analytical level include the use of calibration blanks and standards, check standards, method blanks, laboratory control samples, matrix spike and matrix spike duplicates, internal standards, surrogates, and duplicate samples.

Method blanks and Laboratory Control Samples are completed for every analytical batch. Method blanks are matrix-matched to samples. One matrix spike/matrix spike duplicate set are run every 20 samples, or each week an analytical procedure is performed if there are under 20 samples.

Acceptance limits for compounds must not exceed those prescribed by regulations. If acceptance limits are exceeded, corrective action is immediately taken. Samples run prior to corrective action are re-analyzed, and corrective action forms are reviewed by the Laboratory Director.

6.6 Quality Control Samples

We participate in the EPA WS and WP Performance Evaluation Program. These include a variety of organic and inorganic analytes for drinking water and wastewater analysis, respectively. Reference materials are tested and results of these studies are discussed with the analysts involved and kept on file.

In addition, we participate in a performance evaluation testing program administered by a third party. Blind reference samples are analyzed on a quarterly basis for a variety of organic and inorganic constituents. Results of these studies are discussed with analysts and kept on file.

Clients are encouraged to submit QC samples to us. On request, we will split samples and subcontract to another laboratory as a confirmation check.

6.7 Review and Reporting of Analytical Results

Quantitative results are reviewed by a peer analyst or the analyst's Department Manager and the Laboratory Director before being released. The review process involves comparing related analytical results on the same sample for coherence. It also involves comparison with previous results for the same source to observe possible deviations from established trends. Final review may involve further consultation with clients.

Signed final reports are kept on file for at least five years, along with laboratory worksheets, instrument printouts, and chain of custody forms.

APPENDIX I

CERTIFICATIONS

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFICE OF MANAGEMENT AND TECHNICAL SERVICES

BUREAU OF LABORATORIES



Certifies that

GREAT LAKES ANALYTICAL INC
1008 W 9TH AVE
KING OF PRUSSIA, PA 19406
46-505

Having duly met the requirements of
Chapter 109, Subchapter H, Safe Drinking Water Rules and Regulations
Issued under the Pennsylvania Safe Drinking Water Act of May 1, 1984
(P.L. 206, No. 43), (35 P.S. SS 721.1 - 721.17)
Is hereby approved as a


Certified Drinking Water Laboratory

To perform the following analyses:

Inorganic
Trace Metals (Group 1)

Expiration Date: June 28, 2003

Certificate not transferable
Surrender upon revocation
To Be Conspicuously Displayed at the Laboratory


Roger H. Carlson, PhD, Director
Bureau of Laboratories

State of New Jersey
Department of Environmental Protection

Certifies That

GREAT LAKES ANALYTICAL, INC.
LABORATORY CERTIFICATION ID # PA004

having duly met the requirements of the
Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

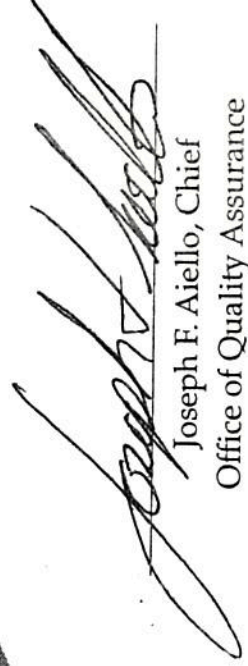
is hereby approved as a

State Certified Environmental Laboratory

*To perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid*

Expiration Date June 30, 2003




Joseph F. Aiello, Chief
Office of Quality Assurance



STATE OF MARYLAND
DEPARTMENT OF HEALTH AND MENTAL HYGIENE
LABORATORIES ADMINISTRATION

Certifies That

GLA LABORATORIES
1008 West Ninth Ave., King of Prussia, PA 19406

*having duly met the requirements of the
Regulations Governing Laboratory Certification
And Standards Of Performance In Accordance With
The Annotated Code of Maryland,
is hereby approved as a*

State Certified Water Quality Laboratory

*To perform the analyses indicated on the Annual Certified Parameter List,
which must accompany this certificate.*

Approved Analyses: Trace Metals 1.

Certification # 253
Date Issued December 3, 2002
Expiration Date December 31, 2003
(Not Transferable)

J. Michael Joseph
Director, Laboratories Administration

This certification is subject to unannounced laboratory inspections

CONSPICUOUSLY DISPLAY IN THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST



STATE OF NEW YORK DEPARTMENT OF HEALTH

Wadsworth Center

The Governor Nelson A. Rockefeller Empire State Plaza

P.O. Box 509

Albany, New York 12201-0509

Patricia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

December 10, 2002

LAB ID 11593
MS CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19506

Dear Mr. Pollock:

In response to your December 3, 2002 faxed request, your laboratory has been accredited for the following:

Solid & Hazardous Waste (SW): - **IGNITIBILITY**
TCLP

Please return all pages of your original 2002-03 NELAP and ELAP SW Certificates of approval, Serial #s 17472 and 17473 within ten (10) days referring to ELAP Correspondence Log # 2002418 when replying. Upon receipt revised Certificates reflecting these changes will be issued.

Sincerely,

Linda L. Madlin
Administrative Assistant
Environmental Laboratory
Approval Program

LLM:mep



STATE OF NEW YORK DEPARTMENT OF HEALTH

Wadsworth Center

The Governor Nelson A. Rockefeller Empire State Plaza

P.O. Box 509

Albany, New York 12201-0509

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

Dear Laboratory Director,

I congratulate you that your laboratory is now NELAP-accredited, having demonstrated compliance with the National Environmental Laboratory Accreditation Conference (NELAC) standards. New York is your NELAP Primary Accrediting Authority (PAA), either because your laboratory is located in New York, or because your laboratory is in a non-NELAP state and you selected New York as your PAA.

Enclosed are revised certificates of accreditation. They are as follows:

NELAP certificates. These certificates bear the NELAP logo in the bottom right-hand corner, and you have received one certificate for each category of accreditation. These certificates list those fields of testing (EPA Program - Method - Analyte) that are within the scope of NELAC and for which your laboratory has satisfied the NELAC requirements.

ELAP certificates. These certificates do not bear the NELAP logo. They list any remaining fields of testing for which you are accredited in New York, but do not have NELAP accreditation. Those remaining fields of testing are either outside the scope of NELAC, or are within the scope of NELAC but your laboratory has not yet satisfied the NELAC PT requirements or has not provided us with method citations.

Please note that either certificate may also reflect recent accreditation changes based on your PT performance. Your old certificates must now be returned to this office.

Your NELAP certificates will be amended and re-issued any time additional fields of testing are added to your accreditation (e.g., if your laboratory meets the NELAC PT requirements for additional analytes, or provides us with any missing method citations).

The designation "NELAP-accredited" demonstrates that your laboratory is recognized nationally to have met the highest standard of quality. Your laboratory is now permitted, and encouraged, to use the enclosed NELAC logo. The NELAC Standard (Section 6.8) strictly defines and limits the use of "NELAP accreditation" and the NELAC logo. If you would like to receive electronically a high-resolution image of the logo ("tif" format), please e-mail the program office at elap@health.state.ny.us

Please do not hesitate to contact the program office at (518) 485-5570 if you have any questions about your certificates or your NELAP accreditation.

Yours sincerely,

Kenneth W. Jackson, Ph.D.
Director, Environmental Laboratory Approval Program

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

Azidines		Chlorinated Hydrocarbons	
3,3-dichlorobenzidine	EPA 625	2-Chloronaphthalene	EPA 625
benzidine	EPA 625	Hexachlorobenzene	EPA 625
Chlorinated Hydrocarbon Pesticides		Hexachlorobutadiene	EPA 625
1,4-DDE	EPA 608	Hexachlorocyclopentadiene	EPA 625
1,4-DDT	EPA 608	Hexachloroethane	EPA 625
1,4-DDD	EPA 608	Demand	
alpha-BHC	EPA 608	Biochemical Oxygen Demand	EPA 405.1
beta-BHC	EPA 608	Chemical Oxygen Demand	Method Not Specified
Chlordane Total	EPA 608	Haloethers	
delta-BHC	EPA 608	4-Bromophenylphenyl ether	EPA 625
Dieldrin	EPA 608	4-Chlorophenylphenyl ether	EPA 625
Endosulfan I	EPA 608	Bis (2-chloroisopropyl) ether	EPA 625
Endosulfan II	EPA 608	Bis(2-chloroethoxy)methane	EPA 625
Endosulfan sulfate	EPA 608	Bis(2-chloroethyl)ether	EPA 625
Endrin	EPA 608	Nitroaromatics and Isophorone	
Endrin aldehyde	EPA 608	2,4-Dinitrotoluene	EPA 625
Heptachlor	EPA 608	2,6-Dinitrotoluene	EPA 625
Heptachlor epoxide	EPA 608	Isophorone	EPA 625
Endrin	Method Not Specified	Nitrobenzene	EPA 625
Endane	EPA 608	Nitrosoamines	
Chlorinated Hydrocarbons		N-Nitrosodimethylamine	EPA 625
2,4-Trichlorobenzene	EPA 625	N-Nitrosodi-n-propylamine	EPA 625

Serial No.: 15997

This certificate is the property of the New York State Department of Health. Valid only at the address shown.
It must be conspicuously posted. Valid certificates have a raised seal and may be
renewed by calling (516) 485-5570.

H-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

trosoamines		Polynuclear Aromatics	
V-Nitrosodiphenylamine	EPA 625	Benzo(k)fluoranthene	EPA 625
ththalate Esters		Chrysene	EPA 625
Benzyi butyl phthalate	EPA 625	Dibenzo(a,h)anthracene	EPA 625
3is(2-ethylhexyl) phthalate	EPA 625	Fluoranthene	EPA 625
Diethyl phthalate	EPA 625	Fluorene	EPA 625
Dimethyl phthalate	EPA 625	Indeno(1,2,3-cd)pyrene	EPA 625
Di-n-butyl phthalate	EPA 625	Naphthalene	EPA 625
Di-n-octyl phthalate	EPA 625	Phenanthrene	EPA 625
lychlorinated Biphenyls		Pyrene	EPA 625
CB-1016	EPA 608	Priority Pollutant Phenols	
CB-1232	EPA 608	2,4,5-Trichlorophenol	SW-846 8270C
CB-1242	EPA 608	2,4,6-Trichlorophenol	Method Not Specified
CB-1248	EPA 608	2,4-Dichlorophenol	EPA 625
CB-1254	EPA 608	2,4-Dimethylphenol	EPA 625
CB-1260	EPA 608	2,4-Dinitrophenol	EPA 625
lynuclear Aromatics		2-Chlorophenol	EPA 625
cenaphthene	EPA 625	2-Methyl-4,6-dinitrophenol	EPA 625
cenaphthylene	EPA 625	2-Nitrophenol	EPA 625
nthracene	EPA 625	4-Chloro-3-methylphenol	EPA 625
enzo(a)anthracene	EPA 625	4-Nitrophenol	EPA 625
enzo(a)pyrene	EPA 625	Pentachlorophenol	EPA 625
enzo(b)fluoranthene	EPA 625	Phenol	Method Not Specified
enzo(ghi)perylene	EPA 625		

erial No.: 15997

pe the New York State Department of Health. Valid only at the address shown.
st conspicuously posted. Valid certificates have a raised seal and may be
ified calling (518) 485-5570.

H-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

Purgeable Aromatics

1,2-Dichlorobenzene	EPA 624
1,3-Dichlorobenzene	EPA 624
1,4-Dichlorobenzene	EPA 624
Benzene	EPA 624
Chlorobenzene	EPA 624
Ethyl benzene	EPA 624
Toluene	EPA 624
Total xylenes	EPA 624

Purgeable Halocarbons

1,1,1-Trichloroethane	EPA 624
1,1,2,2-Tetrachloroethane	EPA 624
1,1,2-Trichloroethane	EPA 624
1,1-Dichloroethane	EPA 624
1,1-Dichloroethene	EPA 624
1,2-Dichloroethane	EPA 624
1,2-Dichloroethene (total)	EPA 624
1,2-Dichloropropane	EPA 624
1-Chloroethylvinyl ether	Method Not Specified
Bromodichloromethane	EPA 624
Bromoform	EPA 624
Bromomethane	EPA 624
Carbon tetrachloride	EPA 624
Chloroethane	EPA 624

Purgeable Halocarbons

Chloroform	EPA 624
Chloromethane	EPA 624
cis-1,3-Dichloropropene	EPA 624
Dibromochloromethane	EPA 624
Methylene chloride	EPA 624
Tetrachloroethene	EPA 624
trans-1,3-Dichloropropene	EPA 624
Trichloroethene	EPA 624
Trichlorofluoromethane	Method Not Specified
Vinyl chloride	EPA 624

Residue

Solids, Total	EPA 160.3
Solids, Total Dissolved	EPA 160.1
Solids, Total Suspended	EPA 160.2

Wastewater Metals I

Barium, Total	EPA 200.7
Cadmium, Total	EPA 200.7
Calcium, Total	EPA 200.7
Chromium, Total	EPA 200.7
Copper, Total	EPA 200.7
Iron, Total	EPA 200.7
Magnesium, Total	EPA 200.7
Manganese, Total	EPA 200.7

Serial No.: 15997

Open to the New York State Department of Health. Valid only at the address shown.
List conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (516) 485-5570.

PH-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

Wastewater Metals I

Nickel, Total	EPA 200.7
Potassium, Total	EPA 200.7
Silver, Total	EPA 200.7
Sodium, Total	EPA 200.7

Wastewater Metals II

Aluminum, Total	EPA 200.7
Arsenic, Total	EPA 200.7
Beryllium, Total	EPA 200.7
Chromium VI	LACHAT 10-124-13-1-A
Mercury, Total	EPA 245.1
Selenium, Total	EPA 200.7
Zinc, Total	EPA 200.7

Wastewater Miscellaneous

Hydrogen Ion (pH)	EPA 150.1
-------------------	-----------

Serial No.: 15997

Open to the New York State Department of Health. Valid only at the address shown.
Use conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (516) 485-5570.

DH-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory in conformance with the
National Environmental Laboratory Accreditation Conference Standards for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Metals I

Barium, Total	SW-846 6010B
Cadmium, Total	SW-846 6010B
Chromium, Total	SW-846 6010B
Lead, Total	SW-846 6010B
Nickel, Total	SW-846 6010B

Metals II

Ar. Total	SW-846 6010B
-----------	--------------

Serial No.: 15998

Property of the New York State Department of Health. Valid only at the address shown.
Must be conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (516) 485-5570.

DH-3317 (3/97)



NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner



Expires 12:01 AM April 01, 2003
Issued June 28, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

NY Lab Id No: 11593
EPA Lab Code: PA00918

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	SW-846 8270C
2-Chloronaphthalene	SW-846 8270C
Hexachlorobenzene	SW-846 8270C
Hexachlorobutadiene	SW-846 8270C
Hexachloroethane	SW-846 8270C

Alcohols

Bis(2-chloroisopropyl) ether	SW-846 8270C
Bis(2-chloroethoxy)methane	SW-846 8270C

Metals I

Silver, Total	SW-846 6010B
---------------	--------------

Metals II

Antimony, Total	SW-846 6010B
Chromium VI	SW-846 7196A
Mercury, Total	SW-846 7471A
Selenium, Total	SW-846 6010B

Miscellaneous

Hydrogen Ion (pH)	SW-846 9040B
	SW-846 9045C
Lead in Paint	SM18 3120B

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	SW-846 8270C
2,6-Dinitrotoluene	SW-846 8270C

Nitroaromatics and Isophorone

Isophorone	Method Not Specified
Nitrobenzene	SW-846 8270C

Phthalate Esters

Benzyl butyl phthalate	SW-846 8270C
Bis(2-ethylhexyl) phthalate	SW-846 8270C
Diethyl phthalate	SW-846 8270C
Dimethyl phthalate	SW-846 8270C
Di-n-butyl phthalate	SW-846 8270C
Di-n-octyl phthalate	SW-846 8270C

Polychlorinated Biphenyls

PCB-1016	SW-846 8082
PCB-1221	SW-846 8082
PCB-1232	SW-846 8082
PCB-1242	SW-846 8082
PCB-1248	SW-846 8082
PCB-1254	SW-846 8082
PCB-1260	SW-846 8082

Polynuclear Aromatic Hydrocarbons

Acenaphthene	SW-846 8270C
Acenaphthylene	SW-846 8270C
Anthracene	SW-846 8270C
Benzo(a)anthracene	SW-846 8270C
Benzo(a)pyrene	SW-846 8270C

Serial No.: 15999

Approved by the New York State Department of Health. Valid only at the address shown.
This certificate is conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (518) 485-5570.

DOH-3317 (3/97)

NEW YORK STATE DEPARTMENT OF
WADSWORTH

Antonia C. Novello, M.D., M.P.H.



CERTIFICATE OF APPROVAL FOR

Issued in accordance with and pursuant to section

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

is hereby APPROVED as an Environmental
ENVIRONMENTAL ANALYSES SOL
All approved subcategories and/or

Sealable Halocarbons

1,3-Dichloropropene	Method Not Specified
Trichloromethane	SW-846 8260B
Dichlorodifluoromethane	SW-846 8260B
Vinyl chloride	SW-846 8260B
1,1-Dichloroethene	SW-846 8260B
1,1,2,2-Tetrachloroethane	Method Not Specified
1,1,1-Trichloroethane	SW-846 8260B
Dichlorofluoromethane	SW-846 8260B
Vinyl chloride	SW-846 8260B

Polynuclear Aromatic Hydrocarbons

Benzo(b)fluoranthene	SW-846 8270C
Benzo(ghi)perylene	SW-846 8270C
Chrysene	SW-846 8270C
Dibenzo(a,h)anthracene	SW-846 8270C
Fluoranthene	SW-846 8270C
Fluorene	SW-846 8270C
Indeno(1,2,3-cd)pyrene	SW-846 8270C
Naphthalene	SW-846 8270C
Phenanthrene	SW-846 8270C
Pyrene	SW-846 8270C

Priority Pollutant Phenols

2,4,6-Trichlorophenol	SW-846 8270C
2,4-Dichlorophenol	SW-846 8270C
2,4-Dimethylphenol	SW-846 8270C
2,4-Dinitrophenol	SW-846 8270C
2-Chlorophenol	SW-846 8270C
2-Methyl-4,6-dinitrophenol	SW-846 8270C
2-Nitrophenol	SW-846 8270C
4-Chloro-3-methylphenol	SW-846 8270C
4-Nitrophenol	SW-846 8270C
Pentachlorophenol	SW-846 8270C
Phenol	SW-846 8270C

NEW YORK STATE DEPARTMENT OF
WADSWORTH

Antonia C. Novello, M.D.



CERTIFICATE OF APPROVAL FOR

Issued in accordance with and pursuant to section

MS. CRYSTAL POLLOCK
GLA LABORATORIES
1008 WEST 9TH AVENUE
KING OF PRUSSIA PA 19406 USA

is hereby APPROVED as an Environmental
ENVIRONMENTAL ANALYSES SOL
All approved subcategories and/or

Initial No.: 15999

This certificate is the property of the New York State Department of Health. Valid only at the address shown.
Must be conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (518) 485-5570.

DOH-3317 (3/97)

Serial No.: 15999

This certificate is the property of the New York State Department of Health. Valid only at the address shown.
Must be conspicuously posted. Valid certificates have a raised seal and may be
verified by calling (518) 485-5570.

DOH-3317 (3/97)



DELAWARE HEALTH
AND SOCIAL SERVICES

DIVISION OF PUBLIC HEALTH

CERTIFICATE OF APPROVAL FOR DRINKING WATER ANALYSIS

issued to

GLA Laboratories

located at

**1008 W. Ninth Avenue
King of Prussia, PA 19406**

is granted approval for enforcement purposes under
the Safe Drinking Water Act
for the following parameters

FULL CERTIFICATION:


Lead, Copper

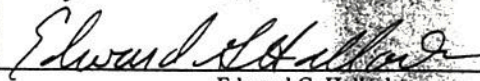
PROVISIONAL CERTIFICATION:

Certificate Number: PA915

Date of Issue: May 23, 2001

Expiration Date: June 28, 2001


Jane P. Getchell, Dr. P.H., HCLD
DIRECTOR OF LABORATORIES


Edward G. Hallöck
PROGRAM ADMINISTRATOR
OFFICE OF DRINKING WATER

APPENDIX II

SEQUOIA LABORATORY NETWORK LOCATIONS AND CERTIFICATIONS

SEQUOIA LABORATORY NETWORK

SEQUOIA ANALYTICAL <http://www.sequoialabs.com>

Morgan Hill

5 Jarvis Drive
Morgan Hill, CA 95037
408-776-9600/ Fax 408-782-6308
Laboratory Director: Diane Lawver email: dlawver@sequoialabs.com
Information Contact: Paul Henige email: phenige@sequoialabs.com

California DHS #1210
Colorado Drinking Water
USDA Foreign Soils Permit

Certifications

Hawaii Dept. of Health
Washington Dept. of Ecology
Nevada LUFT

Walnut Creek

404 North Wiget Lane
Walnut Creek, CA 94598
925-988-9600/ Fax 925-988-9673
Laboratory Director: Alan Kemp email: sequoia7@attmail.com
Information Contact: Kevin Calcagno email: sequoiaklc@aol.com

California DHS #1271
USDA Foreign Soils Permit

Certifications

Nevada LUFT

Sacramento

819 Striker Avenue, Suite 8
Sacramento, CA 95834
916-921-9600/ Fax 916-921-0100
Laboratory Director: Mark Chiaravalloti email: sequoia1@pacbell.net
Information Contact: Kevin Calcagno email: sequoiaklc@aol.com

California DHS #1624

Certifications

Nevada LUFT

Petaluma

1455 N. McDowell Blvd. North, Suite D
Petaluma, CA 94954
707-792-1865 / Fax 707-792-0342
Laboratory Director: Peggy Penner
Information Contacts: David Velasquez, Stacy Hoch
Email: dvelasquez@sequoialabs.com or shoch@sequoialabs.com

California DHS #2374
Washington Dept. of Ecology
AFCEE QAPP 2.0, 1/97 & 3.0, 3/98
Army Corps of Engineers

Certifications

USDA Foreign Soils Permit

San Carlos

1551 Industrial Road
San Carlos, CA 94070
650-232-9600 / Fax 650-232-9612
Laboratory Director: Tim Costello email: sequoialabs@hotmail.com
Information Contact: Paul Henige email: phenige@sequoialabs.com

California DHS #2360

Certifications

Aspen Analytical

1110 Elkton Drive, Suite A
Colorado Springs, CO 80907
719-593-9595/ Fax 719-593-9911
Laboratory Director: Tom Fowler email: aspenanalytical@earthlink.com
Information Contact: Tom Fowler

Colorado Drinking Water

Certifications

California DHS #2000
Utah DHS E-284

ENVIRONMENTAL LABORATORY OF THE PACIFIC www.oceanic-labs.com

Honolulu

930 Mapuanapuna Street, Suite 100
Honolulu, HI 96819
808-831-3090/ Fax 808-831-3098
Laboratory Director: Kenneth Lee
Information Contacts: Kenneth Lee, Dave Velasquez
Email: klee@oceanic-labs.com or dvelasquez@oceanic-labs.com

HAL CA DHS #2142
AFCEE QAPP 2.0
Hawaii Drinking Water-Inorganic Parameters

Certifications

USDA Foreign Soils Permit

SEQUOIA LABORATORY NETWORK

NORTH CREEK ANALYTICAL <http://www.ncalabs.com>

Seattle

3939 120th Ave., N.E., Suite 101
Bothell, WA 98011
425-420-9200/ Fax 425-420-9210
Laboratory Director: Scot Cocanour
Sales Contact: Emily Carfioli icarfioli@ncalabs.com

Certifications

Washington Dept. of Ecology #C008	A2LA #0301-01
Washington Dept. of Health #104	Alaska ADEC - UST-011
Idaho Dept. of Health & Welfare	USDA Foreign Soils Permit
Montana DH&HS #0005	Oregon Dept. of Health #WA081
WA DOE Mobile Lab #C271	Army Corps of Engineers
Oklahoma DEQ #9710	California DHS #I-2294

Spokane

East 11115 Montgomery, Suite B
Spokane, WA 99206
509-924-9200/ Fax 509-924-9290
Laboratory Manager: Dennis Wells
Sales Contact: Dennis Wells dwells@ncalabs.com

Certifications

Washington Dept. of Ecology #C147

Portland

9405 S.W. Nimbus Ave.
Beaverton, OR 97008
503-643-9200/ Fax 503-644-2202
Laboratory Manager: Philip Nerenberg
Sales Contact: Kent Patton kpatton@ncalabs.com

Certifications

Oregon Dept. of Health #OR040	A2LA #0301-02
Washington Dept. of Ecology #C097	Alaska DEC #UST-012
Army Corps of Engineers	

Bend

20354 Empire Avenue, D7
Bend, Oregon 97708
541-383-9310/ Fax 541-382-7588
Laboratory Manager: Kent Patton
Sales Contact: Kent Patton kpatton@ncalabs.com

Certifications

Oregon Dept. of Health #OR908

NCA Shanghai

Shanghai Technical Services Center
No. 1 Nan Dan Road, Room 104
Shanghai 200030
P.R. China
+86-21-6487-8322
+86-21-6439-3186
International Contact: Jianfu Jiao
e-mail: jjiao@ncalabs.com
Domestic Contact: Joy Chang
e-mail: jchang@ncalabs.com

NCA Thailand

Level 23 CP Tower, 313 Silom Road
Bangkok 10500 Thailand
662-231-8072, 01-825-6982
662-231-8121
Director and Sales: Burt Blackburn
e-mail: bblackburn@ncalabs.com

STAR ANALYTICAL

Fort Worth

14500 Trinity Blvd., Suite 106
Fort Worth, TX 76155
817-571-6800/ Fax 817-267-5431
Laboratory Director: Anthony Dilday
Sales Contact: Greg Horton

Certifications

Texas Water Commission approved	A2LA #498-01, Lead (NLLAP)
Oklahoma DEQ #9301	USDA Foreign Soils Permit
Arkansas Dept. of Pollution Control and Ecology	
Tennessee DEC (UST Division)	CA DHS #1849
Texas General Service Commission HUB/M/WBE #1752416658800	

SEQUOIA LABORATORY NETWORK

DEL MAR ANALYTICAL

Irvine

152 Alton Avenue
Irvine, CA 92606
949-261-1022/ Fax 949-261-1228
Laboratory Director: Gary Steube
Sales Contact: Elaine McPherson elaine@mail.dmalabs.com

California DHS #1197
Arizona #AZ0428
USDA Foreign Soils Permit

Certifications

Mobile Lab #1794

Colton

1014 E. Cooley Drive, Suite A
Colton, CA 92324
909-370-4667/ Fax 909-370-1046
Laboratory Manager: Alma Borcuk
Sales Contact: Alma Borcuk alma@dmalabs.com

California DHS #1169
Arizona #AZ0062

Nevada Dept. of Human Resources, Drinking Water
Nevada Division of Environmental Protection, Clean Water
USDA Foreign Soils Permit

Certifications

AFCEE Approved

Van Nuys

16525 Sherman Way, Suite C-11
Van Nuys, CA 91406
818-779-1844/ Fax 818-779-1843
Laboratory Manager: Roan McRae
Sales Contact: Mike Parkinson mparkinson@mail.dmalabs.com

California DHS #1855

Certifications

Arizona

9830 South 51st Street, Suite B120
Phoenix, AZ 85044
602-785-0043/ Fax 602-785-0851
Laboratory Manager: Ian Lambert
Sales Contact: Karen Walters karenw@dmalabs.com

Arizona #AZ0426
Mobile Laboratory #1 #AZM426
Mobile Laboratory #2 #AZM427
USDA Foreign Soils Permit

Certifications

GREAT LAKES ANALYTICAL www.glalabs.com

Chicago

1380 Busch Parkway
Buffalo Grove, IL 60089
847-808-7766/ Fax 847-808-7772
Laboratory Director: Kevin Keeley
Sales Contact: Gary Carbonari gcarbonari@GLALabs.com

Illinois, Drinking Water #100261
Wisconsin, DNR #999917160
Army Corps of Engineers
Tennessee DEC #02804
New York DOH #11487 (32366, 67, 68)

Certifications

A2LA #0461-01
Virginia DGS #00164
Pennsylvania DEP #68500
New Jersey DEP #54001
Delaware DPH #IL069

Philadelphia - GLA Laboratories

1008 W. 9th Avenue
King of Prussia, PA 19406
610-337-9992/ Fax 610-337-9939
Laboratory Director: Crystal Pollock
Sales Contact: Joe Garzio email: jgarzio@glakop.com

Pennsylvania Drinking Water #46-505
Maryland Drinking Water #253
West Virginia Wastewater #226

Certifications

Delaware Drinking Water PA 915
New Jersey Wastewater #77004

Milwaukee

20725 Watertown Road
Brookfield, WI 53186
414-798-1030/ Fax 414-798-1066
Laboratory Director: Steve Jankowski
Information Contacts: Dave Krueger
Email: dkrueger@glalabs.com

Wisconsin, DNR #

Certifications

APPENDIX III

CERTIFICATES OF INSURANCE

ACORD™ CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YY)
02/21/02

PRODUCER 0641361 1-650-369-5900
Professional Practice Insurance Brokers, Inc.
H. Roal and Hamilton Co.
California Street

Wood City, CA 94063
Leslie Pancoast

SURED
Great Lakes Analytical, Inc.
GLA
180 Busch Parkway

Buffalo Grove, IL 60089

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE

INSURER A:
INSURER B:
INSURER C:
INSURER D:
INSURER E: Greenwich Insurance Company

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
GENERAL LIABILITY <input type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS MADE <input type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC				EACH OCCURRENCE \$ FIRE DAMAGE (Any one fire) \$ MED EXP (Any one person) \$ PERSONAL & ADV INJURY \$ GENERAL AGGREGATE \$ PRODUCTS - COMP/OP AGG \$
AUTOMOBILE LIABILITY <input type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> HIRED AUTOS <input type="checkbox"/> NON-OWNED AUTOS				COMBINED SINGLE LIMIT (Ea accident) \$ BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
GARAGE LIABILITY <input type="checkbox"/> ANY AUTO				AUTO ONLY - EA ACCIDENT \$ OTHER THAN AUTO ONLY: EA ACC \$ AGG \$
EXCESS LIABILITY <input type="checkbox"/> OCCUR <input type="checkbox"/> CLAIMS MADE <input type="checkbox"/> DEDUCTIBLE <input type="checkbox"/> RETENTION \$				EACH OCCURRENCE \$ AGGREGATE \$ \$ \$ \$
WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT \$ E.L. DISEASE - EA EMPLOYEE \$ E.L. DISEASE - POLICY LIMIT \$
OTHER Professional Liability	PEC0005212	09/01/00	09/01/02	Per Claim 1,000,000 Ann. Aggregate 1,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

Operations of the named insured.
Professional Liability includes Laboratory Pollution Legal Liability and Laboratory Remediation
General Liability Coverages.
Professional Liability is written at aggregate limits of liability not less than the amount shown.

CERTIFICATE HOLDER

ADDITIONAL INSURED; INSURER LETTER:

CANCELLATION

Great Lakes Analytical, Inc.

One
t 9th Avenue

g of Prusia, PA 19406

USA

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, EXCEPT IN THE EVENT OF CANCELLATION FOR NON-PAYMENT OF PREMIUM IN WHICH CASE 10 DAYS NOTICE WILL BE GIVEN.

AUTHORIZED REPRESENTATIVE
Leslie Pancoast

ORD 25-S (7/97) viven
596627

© ACORD CORPORATION 1988

ORD™ CERTIFICATE OF LIABILITY INSURANCE

09/11/2001

(650)934-0300 FAX (650)934-0495

Insurance

License # 0243213

100 Street, Suite 200
San Jose, CA 94041-2017

Great Lakes Analytical

1380 Busch Parkway

Buffalo Grove, IL 60089

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION
ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE
HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR
ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE

INSURER A: Travelers Insurance (PC)

INSURER B: Fireman's Fund Ins. Co. #721

INSURER C:

INSURER D:

INSURER E:

GES

POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING
REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR
OBTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH
POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
GENERAL LIABILITY	630110D1595	09/01/2001	09/01/2002	EACH OCCURRENCE \$ 1,000,000
COMMERCIAL GENERAL LIABILITY				FIRE DAMAGE (Any one fire) \$ 1,000,000
<input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCUR				MED EXP (Any one person) \$ 10,000
				PERSONAL & ADV INJURY \$ 1,000,000
				GENERAL AGGREGATE \$ 2,000,000
				PRODUCTS - COMP/OP AGG \$ 2,000,000
AGGREGATE LIMIT APPLIES PER:				
POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC				
MOBILE LIABILITY	610110D1595	09/01/2001	09/01/2002	COMBINED SINGLE LIMIT (Per accident) \$ 1,000,000
ANY AUTO				BODILY INJURY (Per person) \$
ALL OWNED AUTOS				BODILY INJURY (Per accident) \$
SCHEDULED AUTOS				PROPERTY DAMAGE (Per accident) \$
HIRED AUTOS				
NON-OWNED AUTOS				
AGE LIABILITY				AUTO ONLY - EA ACCIDENT \$
ANY AUTO				OTHER THAN EA ACC \$
				AUTO ONLY: AGG \$
ESS LIABILITY	XEK84678069	09/01/2001	09/01/2002	EACH OCCURRENCE \$ 4,000,000
OCCUR <input type="checkbox"/> CLAIMS MADE				AGGREGATE \$ 4,000,000
				\$
				\$
				\$
DEDUCTIBLE				\$
RETENTION \$				\$
WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	UB634D0743	09/01/2001	09/01/2002	X WC STATU- TORY LIMITS OTH- ER
				E.L. EACH ACCIDENT \$ 1,000,000
				E.L. DISEASE - EA EMPLOYEE \$ 1,000,000
				E.L. DISEASE - POLICY LIMIT \$ 1,000,000
ER				

ION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

CERTIFICATE HOLDER

ADDITIONAL INSURED; INSURER LETTER:

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE
EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL
30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT,
BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY
OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

Carolyn Camero/TIS677

Carolyn Camero

*****EVIDENCE OF INSURANCE*****

Attn: Joe Garzio

25-S (7/97) FAX: (610)337-9939

©ACORD CORPORATION 1988

APPENDIX IV

RESUMES OF KEY PERSONNEL

KEVIN W. KEELEY

Laboratory Director

Buffalo Grove, IL Laboratory

EDUCATION:

B.S., Chemistry, University of Michigan, 1984

EXPERIENCE:

8/90 - Present *Great Lakes Analytical*
President, Laboratory Director

As President, Mr. Keeley is responsible for the overall operation of the laboratory. His responsibilities in the laboratory include technical review, data review and approval of all personnel and purchasing decisions. In addition to these responsibilities in the laboratory, Mr. Keeley also works with his sales and marketing staff to develop and implement market development plans. Mr. Keeley continues to work with clients in developing analysis plans for site assessment, remediation and waste characterization. Mr. Keeley is responsible for all strategic planning and financial management of the company.

7/89 - 8/90 *Sequoia Analytical; Redwood City, CA*
Vice President of Laboratory Operations

As Vice President of Laboratory Operations, Mr. Keeley was responsible for the operations of the company under the owner/laboratory director. Duties included technical review, personnel and purchasing decisions and data review. Mr. Keeley also worked with the sales and marketing departments in developing sales and marketing plans.

7/88 - 7/89 *GC Department Manager*

As GC Department Manager, Mr. Keeley was responsible for all aspects of operation of the GC laboratory and the interaction of his department with other areas of the laboratory. His responsibilities included the selection and development of his staff, equipment purchases, and the development of new analytical methods.

7/87 - 7/88 *Chromatography Analyst*

As a volatile analyst, Mr. Keeley was responsible for performing EPA Methods 601, 602, 624, 8010, 8020 and 8240. He was responsible for method development and validation, sample preparation, sample analysis and reporting. He was also responsible for all instrument maintenance, troubleshooting, as well as all QA/QC calculations and recordkeeping.

KEVIN W. KEELEY (CONTINUED)*5/86 - 7/87**Waste Conversion; Hatfield, PA
Senior Analyst / QA/QC Coordinator*

Mr. Keeley's analytical responsibilities at Waste Conversion included wet chemical analysis, metals analysis by AA and ICP, PCB analysis, and all methods development. As QA/QC coordinator, Mr. Keeley developed and implemented a program to document the quality of the data produced in the wet chemical, metals and GC laboratories.

*5/85 - 5/86**Applied Geotechnical and Environmental Services; Audubon, PA
Analyst*

Mr. Keeley's analytical responsibilities at AGES primarily consisted of wet chemical techniques. His methods included BOD, COD, cyanide, sulfide, residue, nitrate, nitrite, and sulfates, etc.

TRAINING COURSES:

"Interpretation of Mass Spectra", Finigan

"AA Troubleshooting and Maintenance", Perkin-Elmer

MARGARET SLATER
SEMIVOLATILE DEPARTMENT MANAGER
GLA LABORATORIES

EDUCATION:

Bachelor of Arts in Chemistry
Rutgers University 1991

EXPERIENCE:

6/94 - Present **GLA LABORATORIES**
SEMIVOLATILE DEPARTMENT MANAGER

6/97 - Present *Semivolatile Department Manager:* As Semivolatile Department Manager, Ms. Slater is responsible for the overall management of GLA's semivolatile department. Responsibilities include: scheduling, direct supervision of analysts, data reporting, training, and the implementation of the quality assurance/control program. Primary responsibilities also include working closely with individual analysts in troubleshooting and in developing and validating new methods.

6/95 - 6/97 *GC/GCMS Analyst:* Responsible for the analysis of soils and water samples for volatile organic compounds using EPA methods 602, 624, 8020 and 8260. Other responsibilities include: sample management, extraction, analysis, instrumentation maintenance, data reporting, and quality control reporting.

6/94 - 6/95 *GC Analyst:* Responsible for all aspects of the analysis of pesticides and PCB's using EPA methods 8080 and 608. Other responsibilities include: sample management; sample analysis, troubleshooting, instrumentation maintenance, data reporting and quality control reporting.

8/91 - 6/94 **ANALYTIKEM LABORATORIES**
ANALYST

Responsible for the digestion of samples and their analysis for metals using GFAA, ICP and CVAA. Also responsible for the analysis of samples for pesticides, herbicides and PCB's by gas chromatography.

TRAINING COURSES

ASC Shortcourse Interpretation of Mass Spectra
Hewlett Packard Environmental GC-MS Instrument & Chemstation Operation
Restek Environmental methods Seminar
Restek Capillary Column Seminar

CRYSTAL A. POLLOCK

Vice President
Laboratory Director

EDUCATION:

B.S., Biology, University of Iowa, 1988

EXPERIENCE:

5/94 - Present *GLA Laboratory; King of Prussia, PA*
Laboratory Director; Vice President (5/95 - Present)

As Vice President and Laboratory Director, Ms. Pollock is responsible for all aspects of the King of Prussia laboratory operations. Her responsibilities in the laboratory include: technical review, data review, and approval of all personnel and purchasing decisions. In addition to these responsibilities in the laboratory, Ms. Pollock also works with her sales and marketing staff to develop and implement market development plans. Ms. Pollock continues to work with clients in developing analysis plans for site assessment, remediation, and waste characterization. Ms. Pollock is responsible for all strategic planning of the King of Prussia Laboratory.

8/90 - 5/94 *Great Lakes Analytical; Buffalo Grove, IL*
6/92 - 5/94 *Volatile Organics Department Manager*

As Volatile Organics Department Manager, Ms. Pollock was responsible for all aspects of operation of the GC and GC/MS Volatiles laboratory and the interaction of her department with other areas of the laboratory. Her responsibilities included the selection and development of her staff, equipment purchases, the development of new analytical methods and the management of the day to day operations in the her laboratories.

11/92 - 5/94 *QA/QC Manager*

As a QA Manager, Ms. Pollock was responsible for overseeing the Quality Control Program of the laboratory. She performed weekly QA/QC checks and formal quarterly QA/QC audits for all analysts. Ms. Pollock was also responsible for coordinating all elevated QC packages requested by clients

8/90 - 6/92 *Volatile GC Analyst*

As a volatile analyst, Ms. Pollock was responsible for performing EPA Methods 601, 602, 624, 8010, 8020 and 8240. She was responsible for method development and validation, sample preparation, sample analysis and reporting. Ms. Pollock was also responsible for all instrument maintenance, troubleshooting, as well as all QA/QC calculations and recordkeeping.

CRYSTAL A. POLLOCK (CONTINUED)*8/89 - 8/90**Iowa Beef Processors; Perry, IA
Industrial Chemist*

Ms. Pollock performed chemical analysis of wastewater, insured quality control of meat and rendered products, and collected and analyzed swab cultures from production floors.

OTHER TRAINING:

"Environmental GC-MS (DOS) Operation", Hewlett Packard

"Environmental Chromatography", Resteck

JILL KELLY JANSON**Log-in Manager****EDUCATION:**

B.A., Biology, Immaculata College, 1990

EXPERIENCE:

1/00 - Present GLA Laboratories; King of Prussia, PA
Log-in Manager

As Log-in Manager, Ms. Johnson is responsible for all aspects of the King of Prussia Log-in Department. Her responsibilities include: bottlewear preparation, sample shipping, sample receipt, courier coordination, and customer service. Other responsibilities include the input of all samples into GLA's Environmental Lab Management LIMS System.

11/97 - 99 Recra LabNet Philadelphia; Lionville, PA
Sample Receiving Unit Leader

At Recra LabNet Philadelphia, Ms. Janson was the supervisor for purchasing, shipping, and sample receiving units and her responsibilities included the daily input of all samples received into the LIMS system and the efficient organization and supervision of personnel in order to complete deadlines.

4/91 - 11/97 Roy F. Weston, Inc., Recra LabNet, Philadelphia; Lionville, PA
Chemist III

As a chemist for Roy F. Weston, Inc., Ms. Janson worked in the inorganics division in which she performed all classical chemistry tests and produced raw data and final reports for 75 to 100 samples per day. She was also responsible for the daily organization of personnel, as well as data validation and secondary review of raw data and final reports.

7/90 - 4/91 Roy F. Weston, Inc.; Lionville PA
Senior Technician

As Senior Technician for Roy F. Weston, Inc. in the field unit division, Ms. Janson's responsibilities included traveling to various sites on the East Coast in order to analyze soil and water samples for contaminants using various classical chemistry techniques.

ANDREA SPECK**Project Manager****EDUCATION:**

B.S., Environmental Science/Biology, Kutztown, PA

EXPERIENCE:

10/99 - Present *GLA Laboratories; King of Prussia, PA*
Project Manager

As Project Manager, Ms. Speck is responsible for the day-to-day management of client projects. Her responsibilities include: chain of custody review, data entry and review, report preparation and troubleshooting. In her current position, Ms. Speck is also responsible for pricing, client interactions and customer service.

11/97 - 99 *M.J. Reider Associates*
Organic Chemist

As an organic chemist at M.J. Reider Associates, Ms. Speck was responsible for:

- ◆ ECD (Electron Capture Detector) – HP 5890
- ◆ Tracor 540 GC
- ◆ Volatiles GC/MS – HP 5972 and HP 5973
- ◆ Waters Ion Chromatograph
- ◆ Waters HPLC

Other responsibilities included troubleshooting instruments as well as knowledge of HPChemstation data system on the ECD, as well as EnviroQuant data system on the HP 5972 and the HP 5973.

4/97 - 11/97 *M.J. Reider Associates*
Wet Chemistry Supervisor

As a wet chemistry supervisor, she performed many wet chem analyses such as CN-, Phenols, and NO₃-NO₂ by the Lachat, TKN, PO₄, BOD, and various titrations and colorimetric tests.

ANDREA SPECK (CONTINUED)

1992 – 1997 *Blue Marsh Laboratory*
 Metals Analyst/Lab Technician

Ms. Speck interpreted data from the following instruments: graphite furnace, Perkin Elmer XR6500 ICP, Perkin Elmer Optima 3000XL ICP, and Fisons ICP/MS. Her duties included all wet chemistry analysis, including distillations and metals digestion. Ms. Speck ran all microbiological tests on environmental samples (i.e., plate counts and coliforms).

1990 – 1992 *Silliker Laboratory*
 Laboratory Technician

As a laboratory technician, Ms. Speck performed microbiological testing on food and water samples.

OTHER TRAINING:

Eastern Analytical Symposium – How to Get the Best Results from Your GC.
Eastern Analytical Symposium – HPLC for the Practicing Chromatographer
MDL – Troubleshooting Your GC

CHRISTOPHER D. CURRY
INORGANICS DEPARTMENT MANAGER
GLA LABORATORIES

EDUCATION:

Bachelor of Arts in Geology
Kutztown University 1993

EXPERIENCE:

6/98 - Present **GLA LABORATORIES**
INORGANICS DEPARTMENT MANAGER

As Inorganics Department Manager, Mr. Curry is responsible for the overall management of GLA's inorganic departments. Responsibilities include: scheduling; technical oversight; the direct supervision of analysts; training; data reporting; and the implementation of the quality assurance/quality control program. He also works with the Laboratory Director in establishing staffing levels and making major equipment purchases. Primary responsibilities also include working closely with individual analyst in troubleshooting and in developing and validating new methods. He also reviews data generated within the department for SOP and QAP compliance.

Also responsible for the operation of instrumentation including: TJA ICPA 61E; Varian Flame AA and Varian Furnace AA. Responsible for equipment calibration, maintenance and the TCLP digestion process.

10/94 - 6/98 **BLUE MARSH LABORATORIES**
INORGANIC DEPARTMENT SUPERVISOR

4/97 - 6/98 *Inorganic Department Supervisor* As the Inorganic Department Supervisor, Mr Curry was responsible for the analysis of inorganic and microbiology compounds. The type of analysis supervised by Mr Curry include: titrimetric; colometric; gravimetric; potentiometric and instrument analysis. Specific instrumentation analysis includes: Perkin Elmer 6500/xr ICP; Perkin Elmer Optima 3000 ICP; Buck Scientific Mercury Analyzer and Fisons Eclipse ICP/MS.

9/94 - 4/97 *Wet Chemist Analysts* As a wet Chem Analysts Mr. Curry was responsible for the analysis of Alkalinity, Ammonia, BOD, COD, Cyanide, Fluoride, Hardness, MBAS, pH, Phenols Phosphorus, Solids, and many other compounds using various EPA methods. Also responsible for sample log-in and classification: TCLP Leaching procedures and field sampling methods.

LINDA DOLPHIN LOHR
QUALITY ASSURANCE OFFICER
GLA LABORATORIES**EDUCATION:**

Bachelor of Science in Biology
Millersville University 1974

EXPERIENCE:

6/98 - Present GLA LABORATORIES
QUALITY ASSURANCE OFFICER

As Quality Assurance Officer, Ms. Lohr is responsible for the completion of all regulatory data packages, electronic data submissions and non-conformance reports. The regulatory data packages include but are not limited to the following: NJ reduced data deliverable packages; NY ASP Category B data package and Contract Laboratory data packages. Also responsible for the QA/QC associated with all areas of the laboratory.

6/96 - 6/98 PHARMALYTIC, INC.
ANALYTICAL CHEMIST

Responsibilities included the development of methodologies for analysis of pharmaceutical products. Particular emphasis on creation of GC/MS techniques for both experimental and SOP work. Assisted with compendial testing of pharmaceutical raw materials.

3/89 - 10/93 AGES LABORATORY
LABORATORY MANAGER

Responsible for all aspects of the laboratory operations. Supervision of 10 laboratory analysts, extensive client contact and analytical support. Responsible for establishing AGES as a fully certified laboratory by P DEP and NJ DEP criteria. Direct experience conducting regulatory compliance programs for water supply; ground water; wastewater and hazardous substances. Devised and implemented new analytical methods. Developed and supervised AGES Standard operating Procedure; Quality Assurance/Quality Control programs; Health and Safety program and record keeping.

3/82 - 3/89 COLORCON INC
LABORATORY GROUP LEADER

Responsibilities include supervision of all raw material and finished product testing to ensure material meets FDA, USP, FCC or other international standards. The supervision of a microbiological laboratory.

JOSEPH M. GARZIO**Sales Manager****EDUCATION:**

M.A. (Candidate), Physical Science (Concentration in Geology), West Chester University

B.S., Biology and Environmental Studies, East Stroudsburg University, 1986

A.S., Forest Technology, Williamsport Area Community College, 1983

EXPERIENCE:

4/97 - Present *GLA Laboratories; King of Prussia, PA*
 Sales Manager

As Sales Manager, Mr. Garzio is responsible for sales development and marketing. His sales responsibilities include: price quotes, bid packages, client contract review and implementation, price schedules for common analytical packages, and customer service. His marketing responsibilities include trade shows, advertising, and client interactions.

5/89 - 97 *JACA Corporation; Ft. Washington, PA*
 Environmental Scientist; Biologist

As an environmental scientist at JACA Corporation, Mr. Garzio performed the following:

- ◆ Phase I site assessments
- ◆ Project management for the remediation of hazardous/non-hazardous waste sites
- ◆ Regulatory compliance audits
- ◆ Underground storage tank (UST) compliance
- ◆ Groundwater investigations
- ◆ Health and safety
- ◆ Phase II investigations
- ◆ Marketing

10/88 - 5/89 *Department of Natural Resources and Environmental Control; Dover, DE*
 Environmental Scientist

As an environmental scientist at the Department of Natural Resources and Environmental Control, Mr. Garzio performed regulatory compliance of permitted/unpermitted waste disposal facilities.

APPENDIX V

QUALITY ASSURANCE PROGRAM

QUALITY ASSURANCE PROGRAM
for the
Volatiles, Semivolatiles, Inorganics,
Sample Management, and Client Service Departments

GLA Laboratories
1008 West Ninth Avenue
King of Prussia, PA 19406
(610)-337-9992

Revision: 1.5
Date: January 1, 2002

Signed



Crystal Pollock
Laboratory Director

Signed



Linda Lohr
Quality Assurance Manager

TABLE OF CONTENTS

1. Introduction
 - 1.1 Quality Statement
 - 1.2 Definition
 - 1.3 Scope
 - 1.4 Purpose
 - 1.5 Revisions
2. Organization and Responsibility
 - 2.1 President
 - 2.2 Quality Assurance Manager
 - 2.3 Health & Safety Manager
 - 2.4 Laboratory Director
 - 2.5 Client Services Manager
 - 2.6 Analytical Department Manager
 - 2.7 Project Manager
 - 2.8 Analyst/Extraction Analyst
 - 2.9 Technician
 - 2.10 Assignment of Responsibilities for Absent Individuals
3. Certifications
4. Client Confidentiality, Complaints and Requests
 - 4.1 Client Confidentiality
 - 4.2 Client Complaints
 - 4.3 Client Requests
5. Sampling
 - 5.1 Sampling Containers and Preservation
6. Sample Receipt, Storage, and Tracking
 - 6.1 Chain of Custody
 - 6.2 Laboratory Receipt Documentation
 - 6.3 Sample Integrity Documentation
 - 6.4 Sample Login
 - 6.5 Hazardous Samples
 - 6.6 Sample Storage

TABLE OF CONTENTS (Continued)

- 6. Sample Receipt, Storage, and Tracking (cont.)
 - 6.7 Sample Shipping & Delivery
 - 6.8 Sample Tracking
- 7. Standard Operating Procedures
 - 7.1 Format
 - 7.2 Revisions
 - 7.3 Deviations
 - 7.4 Document Control
- 8. Analytical Quality Control
 - 8.1 Calibration
 - 8.2 Retention Time Windows
 - 8.3 Quantitation
 - 8.4 Method Detection Limit Verification
 - 8.5 Method Blanks and Instrument Checks
 - 8.6 Accuracy
 - 8.7 Precision
 - 8.8 Initial Demonstration of Method Performance (IDMP)
 - 8.9 Surrogates
 - 8.10 Evaluating Quality Control
 - 8.11 Equipment Maintenance and Checks
 - 8.12 Cleaning Procedures
- 9. Corrective Action
- 10. Internal Quality Control Checks
- 11. Internal Audits & Management Review
- 12. Record keeping, Data Review, and Reporting
 - 12.1 Record Keeping
 - 12.2 Data Review
 - 12.3 Reporting
- 13. Training & Ethics
 - 13.1 Training
 - 13.2 Ethics Policy

TABLE OF CONTENTS (Continued)

- 14. Materials, Equipment, and Facilities
 - 14.1 Materials
 - 14.2 Organic Analysis
 - 14.3 Inorganic Analysis
 - 14.4 Sample Preparation
 - 14.5 Field Sampling Equipment
 - 14.6 Sample Storage
 - 14.7 Out-of-Control Equipment
 - 14.8 Facilities Equipment
 - 14.9 Housekeeping
- 15. Record Storage and Electronic Data Procedures
- 16. Glossary of Terms
- 17. Great Lakes Analytical Scope of Tests

Bibliography

- Appendix 1. Laboratory Organizational Chart
- Appendix 2. Laboratory Diagram
- Appendix 3. Chain of Custody Report
- Appendix 4. Sample Acceptance Policy
- Appendix 5. Great Lakes Analytical Standard Footnotes
- Appendix 6. Great Lakes Analytical Ethics and Data Integrity Agreement
- Appendix 7. Demonstration of Capability Certification Statement

1. INTRODUCTION

1.1 Quality Statement

Success in the environmental laboratory marketplace is dependent on three factors: quality, service, and price. Of these, quality is the fundamental factor. Quality is the foundation upon which the other two elements are based. If our clients do not have faith in the quality of our measurements then our product has no value to them. Price and service levels are irrelevant. Clearly, providing quality data to our clients must be the highest priority for the staff at Great Lakes Analytical. This commitment to quality starts with the top management of the laboratory. The Lab Director communicates this commitment to the analytical staff directly through staff meetings, interviews with new employees, and in the laboratories through daily interactions with the analytical staff. Indirectly, it is communicated to the analytical staff through the goals and objectives set by the President for his managers. Finally this commitment and specific quality criteria are communicated to the staff through this document, the Quality Assurance Program, and through method specific standard operating procedures. At Great Lakes Analytical, service may on occasion, be compromised in the pursuit of quality; but quality is never compromised in the pursuit of service. Our objective is to provide the highest quality data available in the laboratory marketplace, on time, and at an affordable price.

1.2 Definition

A Quality Assurance Program is an organization-wide network designed to assure that data produced within that network conforms to the highest standards set by state and/or federal regulations. The network functions at the management level through company goals and management policies; it functions at the analytical level through standard operating procedures and quality control. These two levels are spanned by data control and the reviewing process. The end result is a data package that is accurate, reproducible, and is presented in such a way as to be most useful to the client.

1.3 Scope

Great Lakes Analytical (GLA) analyzes thousands of environmental and industrial samples every month. Chemical and physical parameters must often be measured on the same sample. As such, the Quality Assurance Program must be able to accommodate the complications implicit in the analysis of many samples of widely varying matrices. Analytical methods employed at Great Lakes Analytical are those approved by the US EPA or state regulatory agencies whenever possible. Source documents for these methods include: the latest approved version of *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846; *Methods for the Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, March 1983; *Methods for the Determination of Organic Compounds in Drinking Water*, EPA-600/4-88/039, December 1988; CFR 40 136 Appendix A; *Standard Methods for the Examination of Water and Wastewater*, APHA, 18 ed. 1992; as well as other state and federal publications.

1.4 Purpose

The Quality Assurance Program (QAP) provides a means by which the integrity of data can be verified. Industrial, engineering, and environmental decisions are based on the data produced; therefore, it is essential that clear and extensive verification procedures exist. Accuracy, precision, completeness, and representative results are all aspects of a data package that verify the integrity of the analysis.

The QAP is also a useful historical document. The chronological development of any program relies on the adequate documentation of previous versions. Improvements and modifications can be instituted only if an established frame of reference exists and the comparative efficacy of such changes can be judged.

Lastly, the Quality Assurance Program is the format through which Great Lakes Analytical can express its goals, policies, and commitment toward the generation of data of the highest quality. It expresses how the laboratory will meet those goals through time, resources, and personnel allocations.

1.5 Revisions

The Lab Director and the Quality Assurance Manager will meet annually to review the Quality Assurance Program manual. Justification for revisions to this document includes changes in approved test methods, equipment, laboratory personnel, or accreditation requirements. Each time a revision to the QAP is completed, the QA Manager and Laboratory Director review and approve and then distribute the new revision to all analysts and managers. A sign off sheet and/or training will be administered with the QAP. A copy of all the revisions to the QAP is retained for future reference.

2. ORGANIZATION AND RESPONSIBILITY

Great Lakes Analytical has a structure to facilitate communications between the management and analytical levels. This structure ensures that the final data package produced for the client meets or exceeds regulatory standards. The following is a brief description of the major organizational levels (Figure 1 in Appendix).

2.1 President

The President reports directly to the Chief Executive Officer and the Board of Directors and is responsible for the overall financial, operational, and quality performance of the Corporation.

It is the responsibility of the President to ensure that the QAP is fully implemented at all times. The Quality Assurance Manager reports directly to the President and assists him in monitoring the implementation of the QAP. It is the responsibility of the Laboratory Director to implement the QAP. The President mediates any conflicts that may arise in the interpretation of methods or the QAP between these two managers.

It is the responsibility of the President to ensure that the Chemical Hygiene Plan is fully implemented at all times and that a safe workplace and work practices are maintained. The Health and Safety Manager assists the President in this function.

The Vice President of East Coast operations also reports directly to the President.

2.2 Quality Assurance Manager

The Quality Assurance Manager (QA Manager) is responsible for: overseeing and reviewing the Quality Assurance Program; coordinating and monitoring all quality control procedures; implementing data review procedures; internal checks and annual audits; implementing and monitoring a corrective action procedure; ensuring compliance with state and agency certification requirements; QC data reporting; monitoring employee training; providing required QA/QC related training; and interfacing with the external auditors. The QA Manager updates the laboratory on changes to method requirements and procedures, and is responsible for controlling documentation of written procedures and audits. The QA Manager is also responsible for maintaining the laboratory's certifications and keeping abreast of changes in the programs in which the laboratory participates. All of these responsibilities are independent of the laboratory operations. At no time is the Quality Assurance Manager involved with daily operations or generation of client data.

2.3 Health & Safety Manager

The Health and Safety Manager is responsible for overseeing the Health and Safety program. This includes routine internal health and safety audits of the facility as well as management of the Hazardous Waste Program. The Health and Safety Manager is also responsible for reviewing, revising, and providing training for the Chemical Hygiene Plan.

2.4 Laboratory Director

The Laboratory Director is responsible for all aspects of laboratory operations including the implementation of the QAP. This includes the selection and promotion of staff, the purchase of equipment and instrumentation and the interpretation of analytical methods. The Laboratory Director is also responsible for overseeing the activities of the Analytical Department Managers, and the Client Service Manager. Moreover, the Laboratory Director, along with the President, is in charge of hiring and designating an individual as the Quality Assurance Manager.

As the overseer of the managers and through implementation of standardized procedures, the Laboratory Director is able to ensure that sample acceptance criteria are met, that samples are logged into the sample tracking system correctly, and that the productivity and data reported by the laboratory is of the highest quality possible. Moreover, the Laboratory Director plays a crucial role in working with the Client Services department to resolve service problems. This includes ensuring that all client needs are met and setting appropriate priorities for analytical work.

2.5 Client Services Manager

The Client Services Manager (CSM) is responsible for ensuring that our clients receive the highest levels of service available. The Project Managers, Department Managers Log-In staff and the Drivers assist the CSM in this activity. The CSM works with the QA Manager to ensure that the QAP is implemented in the Login and Project Management areas. The CSM works with the Laboratory Director in setting staffing levels and making major equipment purchases in the department. The CSM also works closely with the Analytical Department Managers to resolve service problems. This includes ensuring that all client needs are met and suggesting appropriate priorities for analytical work.

2.6 Analytical Department Manager

There are three Analytical Department Managers: Inorganics, Semi-Volatile Organics and Volatile Organics. The Analytical Department Managers are responsible for the day-to-day operation of their departments. This includes the scheduling of work, technical oversight, staff training, routine purchasing, budgeting, and the implementation of the Quality Assurance Program and the Chemical Hygiene Plan within their department. The Analytical Department Manager also works with the Laboratory Director in establishing staffing levels and making major equipment purchases. The Department Manager also works closely with the individual analysts in troubleshooting and in developing and validating new methods. The Department Manager also reviews the data generated in their department for SOP and QAP compliance.

2.7 Project Manager

The Project Manager is the primary contact for Great Lakes Analytical's clients. The Project Manager works with the analytical staff and clients in resolving problems originating in login, analytical departments, or administrative areas. The Project Manager works closely with the administrative staff in reviewing reports for typographical errors, and ensuring that client specific reporting requirements are met. The Project Manager is responsible for keeping clients apprised in the progress of their projects.

2.8 Analyst/Extraction Analyst

An analyst is responsible for all aspects of assigned analytical procedures, including overseeing sample preservation and preparation, performing the analysis, and reporting the results. Included in this is the adherence to all quality control procedures specified in the analytical methods or standard operating procedures and the full documentation of these procedures. **The analyst has the responsibility and authority to stop analysis or withhold a result if quality control objectives are not met or resolved according to applicable standard operating procedures or their manager.** In addition, the analyst is responsible for routine maintenance as well as documentation of that maintenance, of their equipment and for having sufficient supplies for analysis. Furthermore, each analyst is responsible for performing their job functions in compliance with the Chemical Hygiene Plan and for proper disposition or disposal of chemicals and samples.

2.9 Technician

The technicians are responsible for both laboratory and field support. Under the supervision of their manager, they are responsible for proper sample pick-ups, deliveries, and general laboratory support. In addition, they are responsible for bottle preparation in accordance with all quality control procedures and relevant standard operating procedures. Each Technician is responsible for performing their duties in compliance with the Chemical Hygiene Plan and for the proper disposition or disposal of chemicals and samples.

2.10 Assignment of Responsibilities for Absent Individuals

In the absence of the following individuals, the indicated designee will assume the responsibilities:

<u>Position</u>	<u>Designee</u>
President	Laboratory Director (Laboratory Production Issues) Quality Assurance Manager (Laboratory Quality Issues) Health / Safety Manager (Laboratory Health/Safety Issues)
Quality Assurance Manager	President
Health and Safety Manager	Laboratory Director (in President's absence) President
Laboratory Director	Laboratory Director (in President's absence) President Department Manager (in President's absence)

3. CERTIFICATION

Great Lakes Analytical has the following certifications:

- New York Department of Health
- New Jersey Department of Environmental Protection.
- Delaware Health and Social Services – Division of Public Health
- Maryland State Department of Health and Mental Hygiene
- Pennsylvania Department of Environmental Protection
- National Environmental Laboratory Accreditation (NELAP)- New York DOH.

4. CLIENT CONFIDENTIALITY, COMPLAINTS AND REQUESTS

4.1 Client Confidentiality

Great Lakes Analytical strives to keep all performed work confidential. All laboratory data, reports, chain of custody forms (COC), correspondence, invoices and any other information associated with clients and their samples are treated with the highest confidence. Communications via telephone or Email are only made to the client, unless the client has given the laboratory permission to discuss issues with other parties. Electronic transmission of information to clients follows this same philosophy. Moreover, the cover sheets to telefacsimiles of information to clients contain the following confidentiality clause:

"The pages accompanying this facsimile transmission contain information from the firm of Great Lakes Analytical. The pages are confidential or privileged. The information is intended for the use of the individual or entity name on this cover sheet. If you are not the intended recipient, be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. If you have received the facsimile in error, please notify us by telephone immediately so that we can arrange for the retrieval of the original documents at no cost to you."

Upon completion of sending a facsimile, the sender will verify that the phone number and number of pages indicated on the transmission confirmation report is correct, and if not appropriate, corrective actions will be taken. Great Lakes Analytical has also incorporated a "no compete" policy, which states that no employee may work for a competitor while employed with Great Lakes Analytical.

4.2 Client Complaints

Client complaints can come to Great Lakes Analytical through various routes: Log-in personnel, Project Managers, the Client Services Manager, Account Managers, or the Laboratory Director. It is the goal of Great Lakes Analytical to carefully listen to these issues and devise strategies that will prevent these problems from recurring.

When a complaint is received, Great Lakes Analytical's Corrective Action Process (see Section 9.0) is followed. In the event that the complaint involves laboratory policies, reporting and documentation, or the quality of the laboratory's calibrations or tests, the QA Manager conducts an internal audit of the area in question. Documentation of complaints, including the receipt problems and actions taken, are recorded on a Corrective Action Form as described in the Corrective Action Process SOP. The corrective actions of the complaints are reviewed and summarized quarterly so that reoccurring problems can be eliminated.

4.3 Client Requests

When the laboratory receives a request for routine analyses, the Project Management staff consults the Laboratory Director and/or the Analytical Department Managers to determine if the work can be accepted. The acceptance of the work is based on current backlog, instrumentation status, and staffing. Moreover, the client's needs, such as desired turnaround time, required certifications, and reporting limits, are also included in the decision-making. If it is determined that the resources are sufficient, the work is accepted. If it is determined that the laboratory can

not meet the client's needs, the Project Management staff will inform the client of the situation, and offer alternate approved subcontracting laboratories that can perform the work.

When a request for non-routine analyses that is out of the scope of routine laboratory work is received, the person receiving the request must first determine whether the laboratory prior to accepting it can handle it. This is accomplished by consulting with the President, the Laboratory Director and/or the appropriate Analytical Department Managers. Upon receiving approval of all required personnel, the work can be accepted.

If Great Lakes Analytical is not able to provide the client requested analysis, an alternate laboratory will be suggested. This subcontracted laboratory would hold any required certifications or accreditations. Before the laboratory subcontracts an analysis, the project manager sends the client a written notice, informing the client of the laboratory's intentions. This documentation is retained with the project notes and reports

5. SAMPLING

Sampling is an important part of any analysis. The result may be only as useful as the quality of the sampling effort. Great Lakes Analytical performs limited sampling for its clients, but does provide sampling containers and advises clients, if requested, of proper sampling procedures, containers and preservation techniques. The laboratory also has a Sample Acceptance Policy available to all sample collectors (see Appendix 4). Moreover, the laboratory's Schedule of Fees and Services document serves as a reference to the samplers for method-required preservatives, containers, and holdtimes.

5.1 Sampling Containers and Preservation

Containers are purchased in large lots from various commercial sources and are equivalent in terms of construction materials and cleaning protocols, to those listed in "Specifications and Guidance for Contaminant-Free Sample Containers", EPA Document 93963316, December 1992. Containers are prepared in a designated area, labeled with the preservative added, affixed with a sample description label, and stored.

Samples brought to Great Lakes Analytical by clients who have done their own sampling are checked for appropriate preservatives, preserved if necessary, documented and stored upon arrival. Preparation of containers is done by technicians relying on Standard Operating Procedures for Bottle Preparation (Refer to the SOP for Receipt of Samples into the Laboratory). Sample containers are provided to clients with the appropriate preservatives as part of the analytical process. SOP's for drinking water sampling procedures are provided to clients who upon request.

6. SAMPLE RECEIPT, STORAGE, and TRACKING

6.1 Chain of Custody

The chain of custody (COC) is the documented history of any sample. It begins at the sample site with the sampling personnel, and accompanies the sample through transport to the laboratory, where it is received and stored under the custody of the laboratory. An example of Great Lakes Analytical's COC may be found in Figure 3 in the Appendix. At a minimum, the COC must include: client name, sample identification; location, date and time of collection; collector's name; preservative added; sample type; and any special remarks. The COC form has designated places to document this information (ex, sample identification is documented in the "Field ID, Location" column, special remarks are documented in the "Comments" section, etc.). Consult the Receipt of Samples into the Laboratory SOP for more detailed information on COC procedures and sample receipt.

6.2 Laboratory Receipt Documentation

When the laboratory receives the samples, the personnel in Sample Control check to ensure that all samples listed on the COC are, in fact, present and in satisfactory condition. They sign and date the COC form and store the samples appropriately in an area that is restricted to Great Lakes Analytical staff only. All shipping receipts, transmittal forms, and internal routing and assignment records are retained for future tracking needs.

In the case where samples are brought in by clients without a COC form, Great Lakes will provide a blank form and then a copy of the completed, signed version of the form to the client.

6.3 Sample Integrity Documentation

In addition to ensuring that the sample is fully documented, the Sample Control personnel are responsible for determining and documenting upon receipt if samples arrive at the method specified temperature (usually 4°C), that there is sufficient sample to do the analyses requested, that they are preserved appropriately, and that holding times have not been violated. Method required preservatives, storage, and holdtimes are listed in Great Lakes Analytical's Schedule of Fees and Services document which is used by the staff to confirm this information. Sample Control personnel are also responsible for splitting those samples that have multiple analyses scheduled, and for compositing.

Samples are either accepted or rejected before information is entered in the laboratory information management system (LIMS) for analysis scheduling. Problems with sample integrity or paperwork inconsistencies are reported to the Client Services Manager or the client's Project Manager who will take corrective action. All correspondence pertaining to rejected samples and receipt problems, including missed holdtimes, incorrect preservatives, and/or insufficient volumes, is documented on the COC and/or corrective action form and then retained in the project file. If the client approves analysis of samples that do not meet the method receipt requirements, the affected sample results are qualified on the final report.

6.4 Sample Login

Upon being received by Great Lakes Analytical, each sample container is given a unique, sequential sample number and stored appropriately in cold storage or at room temperature in an orderly fashion to ensure that the analyst may quickly find the appropriate container for their analysis. Each of these unique, sequential sample numbers are entered into a permanent sequential Sample Receipt Log along with the client's name, the general analytical departments associated with the analytical requests, the turnaround status, and whether the sample is in acceptable condition or not. All of the receipt information is entered into the Laboratory Information Management System (LIMS). This system is the tool used for tracking and scheduling analyses in the laboratory. After the sample information has been entered into the LIMS and reviewed for accuracy of entry, status and scheduling reports are printed. These reports document such things as date sampled, turnaround time, due dates, and holdtimes. These reports are retained in the project folders. The login procedures are covered in the SOP for Receipt of Samples into the Laboratory.

6.5 Hazardous Samples

Hazardous samples are segregated from other samples and from each other by hazard class. These samples are Red-Tagged to identify them as hazardous to all possible handlers. The Red-Tag is a label, with a written description of the hazard, affixed to the sample container. Examples of the hazardous classes include Flammable, Asbestos, PCB's, Cyanides, and Acids. All hazardous samples are disposed of appropriately. Procedures and requirements for Red-Tagging samples are given in the SOP for the Handling of Hazardous Samples and the Chemical Hygiene Plan.

6.6 Sample Storage

Samples are kept in house for six weeks after analysis unless the client has made special arrangements. Storage areas are organized numerically in library fashion. Samples that do not require cold storage are maintained on shelving units. Refrigerated storage areas are maintained at $4^{\circ}\text{C} +$ or $- 2^{\circ}\text{C}$. All samples are stored away from standards, reagents, food, and other contaminating sources. Samples requiring volatiles analysis are kept in separate refrigerator units within the volatiles laboratory. Moreover, drinking water samples requiring volatiles analysis are segregated from all other samples and organic solvent vapors. Laboratory blanks are stored with the volatile samples, and analyzed every two weeks to check for cross-contamination between samples. The storage of sample extracts and other sample preparation products are stored in refrigerators separate from the sample units. Samples are rotated out of the refrigerated storage and onto the shelving units after the originally requested analyses are completed. Daily temperature records are kept for every refrigeration unit.

Analysts and technicians retrieve the sample container allocated to their analysis from storage, analyze the sample, and return it to the shelf from which it originally came. After six weeks of storage, samples are removed from the shelves and disposed of appropriately, unless otherwise specified by the client. Records are kept of sample disposal dates.

6.7 Sample Shipping & Delivery

In the event that Great Lakes needs to ship samples, the samples are placed in a cooler with enough ice to ensure the maintenance of 4 °C. The samples are carefully surrounded by packing to avoid breakage and a trip blank is enclosed for those samples to be analyzed for volatile organic compounds. The COC is signed over to the courier and attached to the shipping paperwork. Samples are generally shipped overnight express or hand delivered by a Great Lakes Analytical courier to maintain sample integrity. For those samples that are hand delivered to the laboratory, the samples are kept at 4°C with ice until logged-in and stored at the laboratories. The integrity of samples that are hand delivered and are not kept at the method required temperatures could be affected. The client is contacted about the issue prior to proceeding with the samples.

6.8 Sample Tracking

Documentation procedures followed by the laboratory allow for complete tracking of all procedures and activities to which samples are subjected. The tracking of samples begins in the field with the sampler completing the COC, and is completed with the release of the final report to the client and the subsequent retention of all records and data pertaining to the samples. This document, along with general and method specific SOPs, explains in detail the laboratory's ability to produce all the necessary data, records and information to track samples. The following outlines the tracking:

1. Identity of personnel involved in sampling, preparation and testing (Sections 6 and 12)
2. Documentation of sample preservation (Section 6)
3. Sample identification code, receipt, login, acceptance or rejection (Section 6)
4. Sample storage and tracking (Section 6)
5. Calculations and statistical formulae use (Sections 8.3, 12 and method specific SOPs)
6. Sample analysis (Section 12 and method specific SOPs)
7. Equipment receipt, use, specification, operating conditions, and preventative maintenance (Sections 8.5, 14 and method specific SOPs)
8. Procedures to verify that the report is free from transcription and calculation errors (Section 14)
9. Data handling (Section 14 and method specific SOPs)
10. QC measurements (Section 8 and method specific SOPs)
11. All information necessary to produce unequivocal records that document the laboratory associated with the sample receipt, analysis and reporting (QAP)
12. Procedures that maintain an unequivocal link with the unique field identification and the laboratory identification code assigned each sample (Section 6)

Great Lakes Analytical does not knowingly analyze litigation samples. Everything analyzed at the laboratory could result in litigation. However, if the laboratory were requested to analyze litigation samples, we would develop procedures that would fulfill the requirements, using EPA's Manual for the Certification of Laboratories Analyzing Drinking Water--Criteria and Procedures Quality Assurance (Fourth Edition) as the guidance document.

7. STANDARD OPERATING PROCEDURES

Standard operating procedures are a central element in the QA program at Great Lakes Analytical. The SOP's serve a number of useful and necessary functions. The first is method conformance. Each SOP has been prepared to ensure that all technical and QC requirements of the source document are met or properly amended. SOP's are also useful as training documents. New analysts study the applicable SOP's before receiving training from senior analysts. SOP's are much more specific than source methods which may be applicable to a wide variety of matrices and types of instrumentation. The SOP is specific to the type of matrix commonly encountered, the equipment types available and the procedure followed at GLA. One of the most important aspects of SOP's is as historical documents. Section 17 lists all the SOPs for each approved test method performed at Great Lakes Analytical.

7.1 Format

SOP's serve to consolidate the many different source documents and procedures used by GLA into an easily accessible guide for the analysts. One SOP may be written for multiple methods that contain identical formats except for the procedure sections. In this case, separate procedures will be written for the different analyses or matrices. All Standard Operating Procedures for laboratory methods will include but are not limited to the following sections or reference where they can be found.

Applicability	Sample Management	Safety
Summary	Method Validation	Quality Control
Equipment	Standards and Reagents	Interferences
Procedure	References	Record Keeping
Maintenance and Troubleshooting		
Waste collection, storage, recycling, and disposal procedures		

Each page of the SOPs includes the following:

SOP Number or ID
Revision Number
Date
Current page number of total pages of the document

7.2 Revisions

Annually, or as equipment or accepted methodologies change, Standard Operating Procedures will be revised. Proposed revisions to SOP's or new SOP's will be reviewed and approved by the appropriate managers for that procedure. In the case of analytical method SOPs, the Department Manager, the QA Manager, and the Laboratory Director's approval is required prior to introduction into the laboratory. Each revision of an SOP has specific applicable dates.

7.3 Deviations and Departures

Any deviations or departures from Standard Operating Procedures or approved source methods must follow the Corrective Action Process, which includes prior approval from a department manager, QA Manager, or the Laboratory Director. Deviations are accepted for unique matrix considerations or special non-standard analytical requests by Great Lakes Analytical clients. Departures from and modifications or clarifications to any approved source methods are documented in the method-specific SOPs.

7.4 Document Control

All SOPs are considered controlled documents. The distribution of these documents follows Great Lakes Analytical's Document Control SOP. In short, this procedure requires a unique number assignment to each copy of a controlled document. A log is kept by the Department Manager, which keeps track of who has each copy. As revisions are made to the documents, the outdated versions are collected and destroyed. Original copies of the outdated versions are archived for at least five years for future reference by the laboratory, clients, and state agencies.

8. ANALYTICAL QUALITY CONTROL

Quality control measurements verify the integrity of the analytical results. While the goal of all quality control procedures remains constant, specific quality control procedures vary from method to method, and to some extent, with matrix type. Each analyst is responsible for a thorough understanding of the goals of the Quality Assurance Program, as well as how the program is implemented in each method. The analyst is also responsible for the documentation of all quality control measurements associated with a particular method.

Great Lakes Analytical adheres to the quality control procedures set out in the latest approved version of *EPA SW-846* for the majority of analytical procedures. Great Lakes also adheres to any additional quality control procedures set out in the latest standards of the National Environmental Laboratory Accreditation Program (NELAP). Other method references may include the *Code of Federal Regulations* Title 40, and *Standard Methods*, 18th Edition, 1992.

8.1 Calibration

Standard operating procedures contain the laboratory's interpretation of the above-mentioned methodologies. For this document, discussions concerning calibration of analytical procedures are of the general nature. Method-specific SOPs should be consulted for more complete information. All calibration activities are documented using a combination of the raw data and logbooks. For gas chromatograph analyses, the initial calibration date is referenced in the data system's method name used to quantitate the data. Moreover, computer data systems used for analyses generate tabulated calibration forms, which include such information as the date, reference to the source method, analytes, standard concentrations, instrument response, and the equation and correlation coefficient for linear regressions. For those analyses where a data system does not automatically generate this information, the analysts record all the calibration information in method-specific logbooks. Specifics on initial calibration standard concentrations are entered into the data systems, and recorded in various run logs and standard preparation logbooks. The raw data and records of all calibrations (hard copies and electronic) are retained by the laboratory.

8.1.1 Initial Calibration for Organic Analyses

The majority of organic instrumentation is calibrated with internal standards. Some instruments, because of the complex nature of the multi-peak chromatograms produced by the method, necessitate the use of external standard calibration.

Initially, each instrument is calibrated for the method for which it is allocated. Once the operating parameters have been established according to the method, the analyst prepares standard solutions containing all the analytes of interest, any internal standards, and any surrogates that are appropriate for the method.

These standard solutions are prepared at different concentrations. One of the concentrations must be just at the reporting limit and the others should define the linear range of the instrument. All of the standard solutions are prepared using Class A volumetric glassware

and the highest quality solvents and stock standards commercially available. The number of standards prepared is determined by the requirements of the particular method.

The standard solutions are introduced into the instrument in the same manner in which the sample or the sample extract would be introduced whether it is by purge and trap or by direct injection. The calibration factor (CF) for those methods that use external standards and the response factor (RF) for those methods that use internal standards are calculated.

Calibration Factors and Response Factors are calculated as follows:

$$\text{Calibration Factor} = \frac{\text{Total Area of Peak}}{\text{Concentration or mass of analyte injected}}$$

$$\text{Response Factor} = \frac{(\text{Area of Analyte})(\text{Conc. of Int. Std.})}{(\text{Area of Int. Std.})(\text{Concentration of Analyte})}$$

The CF's or RF's for each of the concentrations for each of the analytes and surrogates are tabulated. The CF's or RF's for each analyte or surrogate should have a Percent Relative Standard Deviation (% RSD) of less than 20%. The % Relative Standard Deviation is calculated as follows:

$$\%RSD = (SD/x) \times 100$$

Where:

SD = Standard Deviation of initial CF's or RF's for each compound.

x = Mean of initial CF's or RF's for each compound.

If the % RSD is less than 20%, the calibration curve can be considered linear through the origin, and the average CF or RF can be used for quantitation. If the method specifies different criteria (i.e. Method 624), then that criteria will be utilized. If the % RSD is greater than 20%, corrective action is taken. This may involve reanalysis of specific calibration standards, re-preparation of the standards, or instrument maintenance. Some methods allow least squares linear regression to be used for measuring the validity of the initial calibration curve. Linear regressions use the following equation:

$$y = mx + b$$

Where:

y = Instrument response (peak area or height)

m = Slope of the line (also called the coefficient of x)

x = Concentration of the calibration standard

b = The intercept

The regression calculation will generate a correlation coefficient that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit.

In order to be used for quantitative purposes, the coefficient must be greater than or equal to 0.99.

Instrument calibrations are performed when significant changes have occurred on the instrument (ex. change of column), when calibration verification analyses are outside method requirements, or when the analyst deems necessary.

Corrective Action : If method criteria are not met for the calibration, corrective action is performed, and another calibration study is analyzed. At no time are samples or QC analyzed without an acceptable initial calibration in place.

8.1.2 Initial and Continuing Calibration Verifications

The initial calibration curve is further verified by the analysis of an initial calibration verification check standard (ICV). The analyst prepares an ICV from a secondary source or lot number standard solution at a concentration equal to that specified by the method, or if there is no specification in the method, equal to 10% to 50% of the highest standard in the calibration. The ICV is introduced into the instrument in the same manner as the samples and the calibration solutions. Using the calibration factors, response factors, or the linear regression generated from the initial calibration, the quantitated concentration of the analyte(s) in the ICV must be within 15% of the true value for each analyte.

The validity of the calibration curve must be checked daily for most instruments and more frequently for instruments with particularly sensitive detectors that tend to drift. At a minimum, a continuing calibration verification standard (CCV) is analyzed every twelve hours. The analyst prepares the CCV the same as an ICV; however, if the method does not specify the concentration, the CCV is prepared at 25% to 50% of the highest standard in the calibration. The CCV must be within 15% of the true value for each target analyte. If the acceptance criteria specified by the source method is not met, corrective action is performed, and the CCV is reanalyzed. If acceptance criteria are still not met, more corrective action is taken which includes instrument maintenance and recalibration. No samples are analyzed until the initial calibration can be verified with two consecutive and acceptable CCVs. Any samples analyzed after an unacceptable CCV are reanalyzed. Also, since the CCV is prepared from a second source, it is also utilized as the LCS for volatile analyses.

Corrective Action: The check standard must fulfill the above criteria before samples can be analyzed. If the calibration verification is not able to meet the criteria, corrective action must occur. If routine corrective action procedures fail to produce a second consecutive calibration verification (CV), more corrective action must be performed which may include preparing a fresh working standard. If after more vigorous corrective action, two consecutive acceptable CVs are not produced, the initial calibration must be established and verified. Sample data associated with unacceptable CVs may be reported, with qualifiers, under the following scenarios:

- When the acceptance criteria for CVs are exceeded high (i.e. High bias) for an analyte(s), and the associated samples did not contain reportable

levels for the analyte(s), then the non-detects are reported (results are flagged). All samples containing reportable levels of the unacceptable analyte(s) are reanalyzed under an initial calibration that can be verified.

- When the CVs are below the acceptance criteria (i.e. Low bias) for an analyte(s), and the associated samples contained the analyte(s) above the maximum regulatory/client action level, the samples are reported (results are flagged). All samples that did not contain the unacceptable analyte(s) above action levels are reanalyzed under an initial calibration that can be verified.

Some methods have prescribed limits set for the recoveries and concentrations listed above that may be different. It should be noted that individual method specifications would override these general procedures. In addition, there may be calibration procedures prescribed in the method, such as GC/MS tuning with BFB or DFTPP that are not described here in detail but are described in detail in the standard operating procedures for the method.

8.1.3 Calibration for Inorganic Analyses

The majority of inorganic instrumentation is calibrated with external standards. The calibration procedures are much the same for inorganic as they are for organic methods. Please refer to section 8.1.1 above. Most of the calibration procedures require the use of linear regression as a means of measuring the quality of calibration curves. Because of the nature of the technology and the methodology of Inorganics, many samples can be analyzed within a 24-hour period; therefore, inorganic calibration curves are checked on a more frequent basis than organic calibration curves. Consult the specific method SOP for more detail on calibration procedures for Inorganic analyses.

8.2 Retention Time Windows

Most organic analyses use gas chromatography or liquid chromatography instrumentation. As the key to analyte identification in chromatography, retention time windows must be established for every analyte in a particular method on every column used for that method. These records are kept with the notebooks associated with an instrument for later identification and quantitation of the analytes.

Once the analyst has determined that the instrument is in optimum working order through calibration and calibration verification procedures, the analyst uses a mid-range calibration standard to establish the retention times of the individual analytes in a method. The analyst makes 3 injections of the same standard over a 72-hour period, tabulating the retention times for each analyte for each of the 3 injections. The standard deviation of the retention times is then calculated. The retention time window is defined as the average retention time from the daily check standard plus or minus 3 Standard Deviations.

Other criteria has been established and documented for methods that do not allow practical application of RT Windows. As stated in EPA SW846 Rev. 2 & 2A 1992, Method 8000 section 7.5.2.1 "Plus or minus three standard deviations of the retention times for each standard will be

used to determine the retention time window; however, the experience of the analyst should weigh heavily in the interpretation of chromatograms.”

8.3 Quantitation

Organic compounds analyzed by chromatography are tentatively identified by comparing retention times of the sample and the standard. Under most conditions, tentatively identified compounds must be confirmed on a second column of different affinity. Sample quantitation procedures and calculations are outlined in each method depending on the type of calibration used for the method. Instrumentation parameters are documented in the analysts' notebooks.

Similarly inorganic analytes are identified and quantitated by comparing the response of the analyte to the response of the standard. Confirmation is not always possible, although some methods, like metals analyses, allow for a secondary check under a different set of instrument operation parameters. All calculation and instrument operating parameters are recorded in the analysts' notebooks or the SOP.

With all calculations performed in the laboratory, the number of significant figures used is based on the least precise step, and reflects the tolerances of the instrument used.

8.4 Method Detection Limit Verification

The method detection limit (MDL) is determined for each analyte on each instrument allocated to a method on an annual basis. The procedure and requirements for establishing MDL's is taken from 40 CFR Part 136, Appendix B. The analyst prepares at least seven replicates of solution spiked at up to five times the lowest reproducible calibration standard with all the analytes of interest. Each of these aliquots is subjected to the entire analytical process. The Standard Deviation (SD) of seven replicates is calculated. The method detection limit is calculated as follows:

$$\text{Detection Limit} = t_{(n-1, 1-\alpha=0.99)} \times \text{SD}$$

where $t_{(n-1, 1-\alpha=0.99)}$ is Student's T value that is 3.143 for seven replicates. Great Lakes Analytical establishes three distinct limits for reporting purposes. They are:

Method Detection Limit (MDL) - As explained above, this limit is established by the procedure in 40CFR Part 136 App. B. The calculated MDL cannot be greater than the concentration of the standard, nor can it be < 10% of the concentration of the standard used in the study.

Practical Quantitation Limit (PQL) - The PQL is the level above which quantitative results can be obtained with a specific degree of confidence. The PQL is established at ten times the standard deviation from the MDL study. The procedures for establishing the PQL is taken from "Principles of Environmental Analysis", *Analytical Chemistry*, Vol. 55, No. 14, December 1983, 2210-2218.

Reporting Limit (RL) - the Reporting limit is a tool used by the laboratory to establish criteria based on laboratory experience or specific client needs. RL's are always established at or above

the MDL but may or may not be above the PQL. RL's are generally set by client Data Quality Objectives (DQO) or the lowest reproducible standard in the calibration curve.

8.5 Method Blank and Instrument Checks

With each batch of samples processed for a method, a method blank is carried through the complete analytical procedure to check for any laboratory or materials contamination of target analytes. With the exception of a few compounds for a few analyses, the method blank should quantitate to a value of less than half the PQL (or reported detection limit) for the analytes of interest. The exceptions are enumerated in the specific standard operating procedures. In general, if a method blank does not meet the method specific criteria, the samples within the batch are either reprocessed or the results are qualified. If there are no positive detects in the samples, no corrective action is performed. More specific corrective actions are outlined in each analytical standard operating procedure.

Instrument checks, or instrument blanks, are similar to method blanks except they are not subject to the complete analytical procedure. Instrument blanks are usually made up of water, the extraction solvent, or the method reagents. They are analyzed on a regular basis to check for instrument contamination. If target analytes are detected, corrective action is taken before samples are analyzed. More detailed discussion of frequency and corrective actions can be found in the method specific standard operating procedures.

Corrective Action for Method Blanks: : No contamination should be present in the blank above the reporting limit. If contamination is found, samples analyzed after the blank which contain the same contaminates must be reanalyzed to confirm the detects. If the results need to be reported due to client request, a qualifier stating the concentration in the blank is added to the report.

8.6 Accuracy

Accuracy measurements are performed with every analytical batch per matrix type, per sample extraction or preparation procedure. A sample and a blank matrix for the analytical batch is spiked with a known quantity of the analyte(s) and processed in the same manner as the rest of the analytical batch. All target analytes are included in the spiking solution. The accuracy is measured as a percent recovery. The percent recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Calculated Spike Conc.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

The percent recovery of an analyte must fall within the laboratory generated control limits. See section 8.10.1 for discussion of control limit generation.

8.6.1 Laboratory Control Spikes (LCS)

An LCS is essentially a blank matrix (ex. reagent water, clean sand, wipes) fortified with a known amount of test analyte(s). It is identified in the LIMS as a Blank Spike (BS). The

solution used for the spiking is from a source different from that used for calibrating the procedure. For volatiles analysis, the continuing calibration standards also serve as the LCS due to the second-source use. At a minimum, with each matrix-specific batch of samples processed, a LCS is carried through the complete analytical procedure.

Corrective Action: If an LCS (and LCS Dups when needed) does not meet acceptance limits and no target analytes were detected in the associated samples, the sample results are reported with qualifiers. If the associated samples contained analytes of interest that were unacceptable in the LCS, the samples are reanalyzed. However, if the client requests results "as is", the results are reported and qualified. Not all methods performed at Great Lakes Analytical require the analysis of an LCS (ex. Conductivity, pH, turbidity). More detailed discussion of acceptance criteria and corrective action can be found in the method specific standard operating procedures.

8.6.2 Matrix Spikes (MS)

An MS is essentially a sample fortified with a known amount of the test analyte(s). The solution used for the spiking is from a source different from that used for calibrating the procedure. At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.

Corrective Action: If the MS/MSDs do not meet acceptance limits, the associated samples are reported with qualifiers for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reanalyzed to prove matrix interference. Not all methods performed at Great Lakes Analytical require the analysis of an MS (ex. total suspended solids, pH, turbidity). More detailed discussion of acceptance criteria and corrective action can be found in the method specific standard operating procedures.

8.7 Precision

Precision measurements are performed with every analytical batch per matrix type, per sample extraction or preparation procedure. Precision is determined by comparing the analyte recoveries of a sample, matrix spike, or LCS with the recoveries of respective duplicated analyses. The precision is measured as a relative percent difference (RPD) between the two duplicated analyses. The RPD is calculated as follows:

$$RPD = \frac{|\text{Conc. of 1}^{\text{st}} \text{ Analysis} - \text{Conc. of Duplicate Analysis}|}{(\text{Conc. of 1}^{\text{st}} \text{ Analysis} + \text{Conc. of Duplicate Analysis})/2} \times 100\%$$

The RPD for a particular analyte must fall within the control limit established for that analyte. For the procedure for establishing control limits, see section 8.10.1.

8.7.1 Duplicates

At a minimum, with each matrix-specific batch of samples processed, a duplicate sample, matrix spike, or LCS is carried through the complete analytical procedure. Duplicate samples are usually analyzed with methods that do not require matrix spike analysis. Duplicate LCS samples are usually analyzed when insufficient sample volume is supplied for the LIMS specified matrix spike sample. The recoveries for the spiked duplicate samples should meet the same laboratory established recovery limits as the accuracy QC samples.

Corrective Action: If the RPD is not within acceptance limits, the corrective actions in Sections 8.6.1 and 8.6.2 is followed for LCS duplicates and MSDs, respectively. More detailed discussion of acceptance criteria and corrective action can be found in the method specific standard operating procedures.

8.8 Initial Demonstration of Method Performance (IDMP)

Before a particular test method is offered to the public, an Initial Demonstration of Method Performance study is performed by the analyst responsible for the test. This study consists of preparing, processing, and analyzing a minimum of four aliquots of a QC Check Sample or fortified blank matrix of known concentration. The source of the spiking solution is a certified vendor used for the LCS spiking solutions. The spike concentration is approximately 10 times the MDL. The average percent recoveries and standard deviations of the study set must meet the method specified criteria. If the criteria are not met for one or more of the test analytes, the analyst must locate and correct the source of the problem, and repeat that portion of the study, which was deemed unacceptable. Once the study has met all the method criteria, the analysis of actual samples begins. The IDMP is repeated for each method when there is a change in analyst, instrument type, or approved test method. Consult the method specific SOPs for more details on IDMPs.

8.9 Surrogates and Internal Standards

In most organic analyses, surrogate compounds are spiked into all environmental and quality control samples. They act as a secondary check on method accuracy performance in that they should meet established acceptable, matrix-specific recovery limits. Consult the method-specific SOPs for details on the surrogate compounds and acceptance criteria.

Corrective Action: When surrogate standard recoveries fall outside these limits, one sample from each effected project is re-analyzed to confirm a possible matrix effect. If the recoveries confirm, results are reported from the original analysis and a qualifier is added. If the surrogate recoveries fulfill criteria, all affected samples are reanalyzed and results from the re-analyses are reported.

In most organic analyses, internal standards are spiked into all environmental and quality control samples. They are used to construct calibrations (see above). The acceptance criteria in most methods are 50% to 200% of the daily CCV. Consult the method-specific SOPs for details on the internal standard compounds and calculations.

Corrective Action: When recoveries fall outside of the criteria, one sample from each effected project is re-analyzed to confirm a possible matrix effect. If the recoveries confirm, the data is reported from the original analysis and a qualifier is added. If the recoveries of the internal standards fulfill criteria, then all affected samples are reanalyzed and the results from the re-analyses are reported.

8.10 Evaluating Quality Control

In order to assure our clients of the validity of their data, Great Lakes Analytical's analysts have been trained to constantly evaluate the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed above, but also by quality control measurements (ex. method blanks, matrix spikes, LCSs, duplicates, surrogates). In order to demonstrate control over a method, Great Lakes Analytical first determines and quantifies normal performance. To do this we have established certain prerequisites for consistent performance. They are:

1. Use of approved analytical methods.
2. Trained and experienced personnel.
3. Proper facilities and equipment.
4. Certified reagents and standards.
5. Frequent maintenance and calibration of the instruments.
6. Knowledgeable management to oversee the analytical process.
7. Successful performance of IDMP and MDL studies by trained analysts.

When an analytical batch is analyzed, control measures are processed concurrently to assist in assessing the quality of the data generated. The analysts use control limits to evaluate the accuracy and precision in the analytical process. Control limits are developed through the development of control charts.

8.10.1 Control Limits and Charts

In order to evaluate the quality of the data generated, acceptance limits, or control limits, are generated by the laboratory for each method, matrix, and analytical range. When a new method is put into use, or when there are insufficient data points, the control limits are established from those published in the source method or the Quality Control section of the guidance document. After a minimum of 20 data points (ex. 20 matrix spike recoveries) have been collected, the control limits for precision and accuracy are determined by constructing control charts.

The first step in constructing a control chart is determining if the 20 points are a good representation of the data generated by the method. A statistical outlier test (Grubb's Test) is used to "disqualify" data points. Once an acceptable set of at least 20 data points is obtained, the standard deviation and average of the data set is calculated. With these values, the control and warning limits are developed. For accuracy measurements, warning limits are set at two standard deviation units above (upper limit) and below (lower limit) the average. Control limits are set at three standard deviation units above (upper limit) and

below (lower limit) the average. For precision measurements, the warning limit is two standard deviation units above the zero point, and the control limit is three standard deviations above the zero point. The "units" refer to percent recovery for accuracy, and relative percent difference for precision. From this statistically generated data, a graphical control chart is generated. All 20 points are plotted on a graph, where the y-axis equals percent recovery (for accuracy measurements) or relative percent difference (for precision measurements), and the x-axis equal to data point ID. The corresponding average and limit lines are also plotted. Separate control charts are established for each matrix and each QC parameter for each method. All of the control charts/limits include all the above information as well as a title, identification of the SOP and method used, the analyte measured, units of measure, spike concentration, date of analyses, sample ID, and the analysts identification. QC charting and limits are updated on an annual basis.

Limits are established for all analyses performed. All acceptance limits are kept electronically on the LIMS, and hardcopies are maintained in each analyst's QC binder.

8.10.2 Exceptions to Laboratory Generated Control Limits

On an annual basis the analysts, Department Managers and Quality Assurance Manager will review the compiled data points to evaluate the limits. Data will be evaluated for how well the limits fit the data using a method such as the Grubbs Test for out-liers. Warning limits may be established inside the calculated control limits to tighten control over an analysis. Great Lakes Analytical will adhere to any control limits set by a certification program in which the lab participates.

8.11 Equipment Maintenance and Checks

Great Lakes Analytical is dedicated to providing our clients with state-of-the-art technology. Instrumentation is purchased with sensitivity, accuracy, efficiency, and dependability as criteria. All instruments have logbooks in which calibrations, adjustments, routine maintenance, and any repairs are recorded. Calibrations, routine maintenance, and adjustments are part of the analysts' responsibilities. Service contracts are in place for some of the instruments for any major repairs. The highest quality gases, reagents and spare parts are kept on hand to minimize repair time and optimize instrument performance.

Each entry in the instrument logbook includes the date, the analyst, a detailed description of the problem, a detailed explanation of the solution, and a verification that the instrument is functioning properly. In addition, standard operation procedures for organic methods specify and require documentation of routine maintenance procedures like changing of septa in injection ports, changing of gas tanks, and cleaning of detectors. At a minimum, the following records are maintained for each piece of analytical equipment:

Record

Name of equipment
Manufacturer's name and serial number
Dates received and placed in lab

Where stored

Maintenance & Run Logs
Maintenance Log
Maintenance Log (QAP —Sec 14)

Current location	Maintenance Log
Condition upon receipt	Maintenance Log
Manufacturer's instructions	Books maintained in each department
Dates & results of calibrations	Run Logs and raw data files
Details of maintenance performed	Maintenance Log (see above for detail)
History of damage, malfunction, modification or repair	Maintenance Log

8.11.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked regularly. All balances are placed on stable counter tops. Each balance is checked daily with at least two ASTM type 1 weights spanning its range of use. Every month, all balances are checked with the entire range of certified ASTM type 1 weights. The weights used for the checks are recalibrated/recertified annually to NIST standards and are used for no other purpose. All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards. All of this information is recorded in logbooks, and the recalibration/recertification certificates are kept on file. Consult the Balance Check SOP for more information.

8.11.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.1 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use. Conductivity meters are also calibrated before each use with a standard that reflects the sample conductivity. These meters do not exceed an error of 1% or one umhos/cm. Turbidity meters are also calibrated before each use. All of this information is documented in logbooks. Consult pH and Conductivity SOPs for further information.

8.11.3 Thermometers

All thermometers, including liquid-in-glass and digital thermometers, are calibrated on a quarterly basis with a NIST-traceable thermometer. The NIST thermometer is recalibrated annually by an approved outside service, and the provided certificate of traceability is kept on file. The NIST thermometer has increments of 0.2 °C, and has a range applicable to all method and certification requirements. Also, the NIST traceable thermometer is used for no other purpose than to calibrate other thermometers. All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the Thermometer Calibration SOP or method-specific SOPs.

8.11.4 Refrigerators Units, Ovens and Incubators

The temperatures of all refrigerator units used for sample and standard storage are monitored daily. Ovens and incubators are monitored on days of use. All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring. Refrigerator temperatures are kept between 6°C and 0.1 °C. Specific temperature settings/ranges for ovens and incubators can be found in method specific SOPs. All of this information is documented in various departmental Daily Temperature Logbooks and method-specific logbooks.

8.11.5 Autopipettors, Dilutors, and Syringes

The laboratory maintains a sufficient inventory of autopipettors and dilutors of differing capacities that fulfill all method requirements. These devices are given unique identification numbers, and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis. Consult the Verification of Autopipette Delivery SOP for more detail.

Syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

8.12 Cleaning Procedures

The following is the general cleaning procedures used for most analytical glassware at Great Lakes Analytical.

1. Rinse with hot tap water.
2. Scrub with detergent.
3. Rinse 3 times with hot tap water.
4. Rinse 3 times with deionized water.
5. Air dry and store.

Specific EPA methods require procedures that may vary from the cleaning procedures listed above. These specific standard operating procedures are posted in the glassware cleaning area and are kept on file with the appropriate analysts and the Quality Assurance Manager.

10. INTERNAL QUALITY CONTROL CHECKS

Great Lakes Analytical utilizes five different organizations to participate in eight Performance Evaluation programs. All are single blind and scheduled throughout the year. The list of programs is as follows:

<u>Organization</u>	<u>Program</u>	<u>Analysis Sets</u>
<u>Annually</u>		
Environmental Research Associates (ERA)	WP Waterwater	2
Environmental Research Associates	WS Drinking Water	2
New York Department of Health	Waste Water, Solid Waste	2

Clients are encouraged to submit quality control samples to Great Lakes and on request, arrangements will be made to split samples and subcontract to another laboratory as a confirmatory check.

In addition, a stock of performance evaluation samples are kept to be administered blind to the analyst at the discretion of the QA Manager for more frequent internal performance checks.

11. INTERNAL AUDITS & MANAGERIAL REVIEW

Performance audits are done, at a minimum, annually for every analyst. The audit responsibility can be divided between the QA Manager and the Department Manager, with each performing the audits. Audit forms have been designed for each analysis type to focus on the important documentation and procedural steps.

The auditors review the analyst's notebook for documentation of all quality control measurements, their frequency, and the clarity of the documentation. The notebook must be useful to any person who wishes to inspect the history of the analysis. Analysts must also have equipment logs, repair manuals, and adequate tools to keep instruments calibrated. The analyst's data reporting procedures are also reviewed to ensure that results can be easily traced to a notebook. Also, each staff member is interviewed, which includes asking the staff open-ended questions that pertain the analysis or procedure being performed. All areas of the laboratory are audited, including sample control, organics, inorganics, and project management.

Once the audit is completed, the auditors write-up their findings in a report. The auditors meet with each department manager, and discuss the findings and possible corrective actions. The Department Manager reviews the findings with their respective staff, and develops corrective actions for all deficiencies, along with a timeline for completion. All of the findings and communication is documented through typed documents and Emails. The following is the yearly schedule for internal audits and responses:

<u>Task/Activity</u>	<u>Scheduled Time</u>
Internal audit is performed	January/February
Completion of report	2 weeks after completion of audit
Meet with Dept. Managers	1 week after report completion
Corrective Action Plan response	1 month after meeting

The QA Manager monitors the progress of the corrective actions, and ensures their completion by the agreed completion date. If, through an internal audit, it is ever identified that an analysis performed in the laboratory is "defective" or causing inaccurate measurements, the client is informed immediately by telephone, followed by a written notification.

At least monthly, the President holds a managerial meeting to discuss operations and quality assurance issues. This serves as a forum to discuss current quality system issues.

Quarterly, the QA Manager charts the general Corrective Action Reports and disperses the findings to the management team. This serves as the discussion topic for one other the monthly meetings.

Annually the President, QA Manager, and Laboratory Director review the internal and external audit findings, and implement any additional changes necessary to improve the quality system. This meeting takes place annually in the first quarter and is documented.

12. RECORDKEEPING, DATA REVIEW, AND REPORTING

12.1 Record keeping

- 12.1.1. The QA Manager has the responsibility for maintaining a master log of all log books issued to analysts.
- 12.1.2. All logbooks are issued a unique identification number. Log books are labeled with the following information:
 - 12.1.2.1. Log Book Title
 - 12.1.2.2. Identification Number
 - 12.1.2.3. Issue Date
 - 12.1.2.4. End Date
- 12.1.3. When filling out data logbooks with preprinted rows and columns specific to a particular test, all applicable spaces must be filled out. If a space is not used a line will be drawn through it. For un-formatted data log books the following information must be recorded:
 - 12.1.3.1. Full Sample Number
 - 12.1.3.1. Matrix Type
 - 12.1.3.3. Method
 - 12.1.3.4. Amount of sample used
 - 12.1.3.5. Dilutions complete with units
 - 12.1.3.6. GLA Code Number for standards used
 - 12.1.3.7. Lot Number for solvents/acids (if applicable)
 - 12.1.3.8. Results (if applicable), with units
 - 12.1.3.9. Analysts Initials
 - 12.1.3.10. Date of Analysis
- 12.1.4. All entries into laboratory notebooks must be in pen and be neat and legible. Mistakes will be crossed-out with a single line and initialed and dated. Pencil, whiteout and obliterated errors are unacceptable.
- 12.1.5. Unused or partially used pages must be "Z'd" out.
- 12.1.6. All calculations will be shown or represented with a generic calculation at the front of the notebook and/or in the corresponding SOP.
- 12.1.7. For more complex and long bench time tests it is not uncommon for multiple analysts to work on a single batch or page. This may involve analysts on the same shift or a shift-to-shift continuation of the analytical process. Many of the preprinted logbooks incorporate spaces for multiple analysts' initials at various stages in the analytical process. Any time an entry is made by an analyst other than the "signing" analyst it will be accompanied by the analyst's initials and date of the entry.

- 12.1.8. Completed lab notebooks are to be labeled with the date of the last entry and turned in to the QA Manager. Any unused pages will be "Z'd" out.
- 12.1.9 All raw data associated with sample and QC analysis includes the laboratory sample identification code, the date of analysis, reference to instrument identification and operating conditions, the analysis type, all calculations, automated or manual, to which the sample data is subjected, and the analyst's initials or signature.
- 12.1.9 Electronically maintained records are kept in such a fashion as to indicate any change in the record. This is fulfilled automatically by the data systems, or through renaming the changed record with an extension (ex. report 9012049 had a typo, and was edited; the changed file is saved as 9012049A). This preserves the "trackability" of the sample.

12.2 Data Review

The review function is one of the most important activities in the laboratory. The ability of the laboratory to provide its clients with valid and error-free data is essential. For every sample that is submitted to the laboratory for analysis, three review steps are conducted prior to submitting the final report to the client: (1)- Review of the information that is entered into the LIMS; (2)- Review of the data generated for each analysis performed on the sample; (3)- Review of the final report generated through the LIMS. If errors or deviations from standard procedures are discovered during a review process, corrective action is performed. This could include correcting entries in the LIMS, qualifying data, and/or the reanalysis of the sample(s). These review steps ensure that the client receives analytical results that are defensible and of high quality. Consult the Reviewing of Data and Reports SOP (GLA-Review-BG) for detailed information on reviewing procedures.

12.3 Reporting

At a minimum the standard laboratory report shall contain the following information:

- A report title with a "Sample Results" column header
- Each report page is printed on Great Lakes Analytical's letterhead, which includes the laboratory's name, address, phone number, and accreditation/certification numbers.
- Each report contains a electronic file identification, and the page number of total pages for that specific section
- Client name and address
- Client project manager or contact
- Client sample identification and project name or number
- Laboratory sample number
- Date sampled
- Date received
- Date extracted or digested (if applicable); time of preparation or analysis took place if holdtime is ≤ 48 hours.
- Date analyzed

- Method of analysis including EPA method code (if applicable)
- Practical Quantitation Limit or Reporting Limit
- Method Detection Limit (if required)
- Sample results
- Definition of ND
- Elevated detection limit statement if sample was reported at a dilution
- QC data consisting of Surrogate, LCS and MS/MSD recoveries and control limits (if requested)
- Identification of any unacceptable QC analyses or any other unusual circumstances or observations associated with samples. This is usually in the form of a footnote or qualifier. See Appendix 5 for a list of Great Lakes Analytical's Standard Footnotes. Please note that this list is dynamic, and the most current list of qualifiers resides electronically in the LIMS.
- Signature of the Project Manager.
- Copy of the COC.
- For subcontracted work, all of the above is identified on the report.
- Besides the above-mentioned qualifiers, the cover letter of the report includes a statement expressing the validity of the results, that the source methodology was followed; all results were reviewed for error, and any conclusions drawn from the analyses.
- The cover letter includes a statement stating that the report cannot be reproduced, except in full, without written approval of the laboratory, where appropriate.
- The cover letter includes a statement stating when applicable, that the sample results relate only to the analytes of interest tested or to the sample as received by the laboratory.
- If Great Lakes Analytical was responsible for sampling, a statement regarding the sampling procedures used is included in the report.
- If specific accreditation or certification requirements are not met, a narrative is added to the report that explains the issue and corrective action taken.

The Project Manager reviews the results, and checks that the analyses performed are appropriate to the client's requests. Related analyses from the same sample are compared for coherence, and the data is compared with previous results from the same source to observe any deviations from established trends. Unusually high results, or those clearly in violation of discharge limits or hazardous waste standards, are reviewed carefully for any reporting unit errors and frequently trigger an examination of the analyst's notebook and instrument printouts to check for calculation errors. The Project Manager verifies that data is flagged as necessary.

The Project Manager signs the report after their final review of the report. Copies of final reports are kept in a secure filing area for a minimum of 5 years (as of 12/11/00) and include the original laboratory worksheets, any relevant corrective action reports, client correspondence notes, and the COC. Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Any revised reports include all the above information along with justification for the revision. These supplemental reports are retained with the rest of the project records.

13. TRAINING & ETHICS

13.1 Training

When reporting for work for the first time, all new employees receive a copy of the Personnel Policy Manual, and, if appropriate for their job function, the Chemical Hygiene Plan, and a copy of the Quality Assurance Program manual. These are his or hers to keep as part of his or her reference materials. The sole responsibility of the new employee is to read and understand the contents of these manuals. Once the new employee has read and understood the contents of the manual, he or she must sign a document that states that he or she agrees to adhere to the requirements prescribed therein. Within the first month of employment, each employee receives more extensive training on quality assurance practices and health and safety procedures through viewing of instructional videos and training sessions with the QA Manager. Additionally, new employees are required to enter their initials and signature into the Initials Logbook, as well as supply the QA Manager with a resume which outlines the employee's qualifications, education, experience and training.

The Personnel Policy Manual contains information about the company's history and objectives, administrative scheduling, benefits, and general administrative policies.

The Chemical Hygiene Plan contains pertinent information about the chemicals to which employees may be exposed and how to properly interact with those chemicals, preventative procedures to avoid emergencies as well as procedures to cope with emergencies like spills, injuries and fire.

The Quality Assurance Program manual contains information about the goals of the Quality Assurance Program and their implementation.

Before new analysts (trainees) are able to perform analyses on samples, they must serve an apprenticeship under a qualified, experienced analyst (trainer). Before working in the laboratory, the trainee reads the corresponding SOP and source method, asking questions of the trainer for clarifications. Once familiar with the requirements of the method, the trainee observes the trainer perform the analysis. Gradually, the trainee helps at various steps in the process in the presence of the trainer. Eventually, the new analyst will perform the entire analysis in the presence of the trainer to ensure adequate proficiency. Once the new analyst has demonstrated proficiency in the analytical procedures and has demonstrated the ability to maintain quality assurance documentation, he or she will analyze and submit results for an IDMP study and a blind performance evaluation sample. These analyses are performed independently. The results of these analyses are reviewed by the Department Manager. The results of these QC measurements must fulfill the acceptance criteria specified in the method-specific SOP. If the results are not acceptable, the trainee continues working with the trainer to improve any technique issues. The IDMP and blind sample analysis is repeated until successful. Once the QC analysis is complete and acceptable, the Department Manager must be satisfied that the new analyst understands the methods he or she will be performing, the quality control parameters, and documentation of any corrective action that may be necessary. Once the manager is satisfied with the trainee's performance, the Demonstration of Capability Certification Statement (see Appendix 7) is signed by both the Department Manager and the Quality Assurance Manager, and the new analyst is capable of assuming responsibility for the

analysis. Regular auditing by quality assurance staff members ensures continued compliance with Quality Assurance requirements. All trained employees repeat the blind performance evaluation sample analysis annually.

No employee can perform an analysis without completing the above training. In certain situations, if the employee has six months laboratory experience performing the analysis or has satisfactorily completed a minimum of four hours training that is offered by the equipment manufacturer or other qualified training facility, the apprenticeship can be waived. However, the IDMP and blind sample still must be analyzed. No employee can train employees without completion of the above, as well as training on the Employee Training SOP.

New analysts shall possess a bachelor's degree in a natural or physical science or have completed enough course work in chemistry to equal a major in chemistry. Moreover, experience can offset the educational requirements (such as, one year of experience performing the applicable duties equals one year of education).

New technicians, or analysts-in-training, shall possess a minimum of a high school diploma and shall have either satisfactorily completed a minimum of four hours training that is offered by the equipment manufacturer or other qualified training facility, or completed the two week apprenticeship explained above. All of the above explained training is required, and all work produced by the technician is reviewed and verified by senior analysts or the department manager.

The management team must also fulfill minimum requirements for employment. The laboratory director shall hold a minimum of a bachelor's degree in a natural or physical science or have completed enough course work in chemistry to equal a major in chemistry, have a minimum of two years experience managing a laboratory, and be an employee of the laboratory. Department Managers shall hold a minimum of a bachelor's degree in a natural or physical science or have completed enough course work in chemistry to equal a major in chemistry, have a minimum of one years experience in the analyses pertaining to the applicable fields of testing, and be an employee of the laboratory. The QA Manager shall hold a minimum of a bachelor's degree in a natural or physical science or have completed enough course work in chemistry to equal a major in chemistry, have a minimum of one years experience as an analyst in a laboratory, have documented training in quality assurance and quality control, and be an employee of the laboratory. The management staff must also follow the same procedures as analysts before performing any analyses

All training received by employees is documented on standardized forms. Each employee has a training folder on file with the QA Manager that contains the completed training forms, any other training documentation including initial demonstration data, and a resume outlining their qualifications. For complete instructions on Great Lakes Analytical's training program, consult the Employee Training SOP.

13.2 Ethics Policy

All new employees are required to read, understand and sign Great Lakes Analytical's Ethics and Data Integrity Agreement (see Appendix 6 for more information).

14. MATERIALS, EQUIPMENT AND FACILITIES

14.1 Materials

Great Lakes Analytical uses only standards and reagents of high quality and reliability. The grades, ratings, and /or purities of the chemicals and materials used in the laboratory equal or exceed the source methodology requirements. Information including date received, date opened, storage, and expiration dates for all chemicals is documented by use of labels and logbooks. More detailed information on the documentation of standards, chemicals, reagents, and materials can be found in the Chemical and Reagent Receipt and Tracking SOP.

14.1.1 Standards

All neat and commercially mixed standards and spiking solutions used in the laboratory are traceable to a national standard. Certificates of traceability for each standard are kept on file. The preparation of working and intermediate standards is documented in Standard Preparation Logbooks. The documentation includes supplier, lot number, concentration, any dilutions made, preparation and expiration date and a unique code to identify the standard. The documentation of the use of the standard is accompanied by the code at every entry in the analyst's notebook so that traceability to the purchased stock or neat standards can occur. Complete information on the use of each standard is documented in various department-specific standard preparation logbooks.

14.1.2 Reagents and Gases

Chemicals and reagents used in the laboratory are of reagent grade (AR) or better. The preparation of working and intermediate reagents is documented in Reagent Preparation Logbooks. The documentation includes supplier, lot number, concentration, any dilutions made, preparation and expiration date and a unique code to identify the standard. The documentation of the use of the reagent is accompanied by the code at every entry in the analysis logbooks so that traceability to the purchased chemicals can occur. Gases used for gas chromatographs are of zero grade or better. Gas lines have hydrocarbon and moisture traps inline for further purification.

14.1.3 Sources of Water

There are essentially three types of water used for analysis at Great Lakes Environmental. Volatile analysis methods use commercially purchased drinking water. All other areas use either Type I or Type II water. Type II water is deionized water, and Type I is deionized water processed through a Barnstead E-Pure Water Purification System. Both water sources are checked daily for resistivity values. Type II must have a resistivity value at least 0.5 megaohm-cm (conductivity less than 2.0 umhos/cm) at 25°C. Type I water must have a resistivity value of at least 10 megaohm-cm.

14.1.4 Glassware

The quality of glassware used for analytical procedures meets or exceeds the requirements of the source methods. Volumetric glassware is ASTM Class A. Glassware used for purposes that may cause damage from heat or chemicals is made of borosilicate. Standardized procedures for glassware cleaning can be found in the method-specific SOPs (see also section 8.12 above).

14.2 Organic Analytical Equipment

14.2.1 Gas Chromatography/Mass Spectroscopy (GC/MS)

14.2.1 Gas Chromatography/Mass Spectroscopy (GC/MS)

GC/MS-1

Hewlett-Packard 5972 Mass Selective Detector
Hewlett-Packard 5890 II Gas Chromatograph
Restek RTX - 502.2 60M X 0.53 mm column for EPA Method 624, 8260
Tekmar LSC 3000 Purge and Trap
Varian Archon Purge & Trap Autosampler
MS-DOS Instrumentation Control software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-2

Hewlett-Packard 5971 Mass Selective Detector
Hewlett-Packard 5890 A Gas Chromatograph
Restek RTX - 502.2 60M X 0.53 mm column for EPA Method 624, 8260
Tekmar LSC 3000 Purge and Trap
Varian Archon Purge & Trap Autosampler
MS-DOS Instrumentation Control software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-3

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
J&W DB5MS 0.25mm X 30M Column for EPA 8270.
Hewlett-Packard 7673A Auto-sampler.
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-4

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
J&W DB5MS 0.25mm X 30M Column for EPA 8270.
Hewlett-Packard 7673A Auto-sampler.
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-5

Hewlett-Packard 5973 Mass Selective Detector
Hewlett-Packard 6890 Gas Chromatograph
Restek RTX - 502.2 60M X 0.53 mm column for EPA Method 624, 8260
Tekmar LSC 3000 Purge and Trap
Varian Archon Purge & Trap Autosampler
MS-DOS Instrumentation Control software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

14.2.2 Gas Chromatographs

GC-1

Hewlett-Packard 5890 Gas Chromatograph
Restek RTX CLP-Pest 30M 0.25mm Columns for 8081, 8082
ECD/ECD Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Hewlett-Packard 7673A Auto-sampler

GC-2

Hewlett-Packard 5890 Gas Chromatograph
J&W DB5 30M 0.25mm Column for DRO 8015
Hewlett Packard FID Detector
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Hewlett-Packard 7673A Auto-sampler

GC-3

Hewlett-Packard 5890 II Gas Chromatograph
Restek 502.2 0.53 mm X 60 M Column for Methods 8021, TPH-Gas, GRO/PVOC
FID/PID Detectors
Tekmar 2000 Purge and Trap
Tekmar ALS 2016 Autosampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC-4

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB17 30M X 0.25 mm and DB5 0.25mm X 30 M columns for Methods 8081, 8082
ECD/ECD Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC-5

Hewlett-Packard 5890 IIGas Chromatograph

J&W DB17 30M X 0.25 mm and DB5 0.25mm X 30 M columns for Methods 8081, 8082

ECD/ECD Detectors

MS-DOS Instrumentation Control Software

Hewlett-Packard Chemstation and Enviroquant Target Data Management System

14.3 Inorganic Analytical Instrumentation

14.3.1 Trace Metal Analytical Instrumentation (AA and ICP)

Thermal Jarrel Ash 61E ICP

Thermal Jarrel Ash AS300 Autosampler

Thermal Jarrel Ash ThermoSpec Data Acquisition System

Epson LQ-571+ Printer

Varian SpectrAA-20 Atomic Absorption Spectrophotometer

Varian VGA 76 Hydride Generator

Epson FX-880 Printer

Varian SpectrAA-400 Atomic Absorption Spectrophotometer

Zeeman Graphite Tube Atomizer

Varian PSD97Z Programmable Sampling System

IBM PS2 30286 Data System

Epson LX-300 Printer

Thermo Elemental Solar MQZ AA Spectrometer

GF95 Zeeman Graphite Furnace

F595 Furnace Autosampler

733 mhz W98 P111 system with software

GFAA TV

14.3.2 General Chemistry Analytical Instrumentation

Sartorius AC10P Analytical Balance

Corning 340 pH/Ion Meter

O'Haus Top Loading Balances

Cleveland Open and Closed Cup Flash Point Testers

Foxboro Miran 1A CVF IR Spectrometer

Fisher Isotemp Oven

Thermolyne 1400 Muffle Furnace

Hanna HI 9033 Conductivity Meter

YSI 50B DO Meter

Lachat Quikchem AE Automated Ion Analyzer

Precision Scientific 815 Low Temperature Incubator

Orbeco Hellige Turbidimeter

Hach COD Reactor

Milton Roy Spectronic 301 Spectrometer

Barnstead E-Pure Water Purification System

Sartorius LC6200S Top Loading Balance

Sartorius PT-600 Top Loading Balances (2)

Ohaus CT600S Top loading Balance

14.4 Sample Preparation

Q-Wave 3000 Questron Microwave Digestion System

Environmental Express Hot Block Digester (2)

Thermolyne 2200 Hot Plate

Six-foot fume hood (5)

Heating System/Ultrasonics XL Sonicator

Precision Water Bath. (2)

Baxter Ultrasonic Water Bath
Organomation OA SYS N-Evap
Millipore TCLP Zero Head Space Extractor (4)
Activated Charcoal Positive Pressure Hood (1).
Environmental Express 12 Place TCLP Rotator
Millipore 4 Place TCLP Rotator
Dade Multi-tube Vortexer
Environmental Express SPE Extraction System

14.5 Field Sampling Equipment

Isco 2910 Composite Sampler (1)

14.6 Sample Storage

Refrigerated Storage: Approximately 200 cubic feet in 6 separate and temperature-monitored refrigerators.

Unrefrigerated Sample Storage: Approximately 393 square feet of shelving for sample storageBlue

14.7 Out-of-Service Equipment

Any equipment found to give suspect results, or is taken offline from production due to mechanical problems is categorized as "Out-of-Service." If it is determined that the equipment will not be repaired in the near future, it is moved to the back warehouse, and stored on the "Out-of Service" equipment shelves. Equipment that is to be repaired for use is labeled as "Out-of-Service" and an entry in the maintenance logbook is made stating the date and status of the equipment. No equipment categorized as "Out-of-Service" is used for analyses until it is proven to be able to fulfill all method requirements, including calibration, verification, and tuning.

14.8 Facility's Equipment

Great Lakes Analytical's laboratory occupies a 14,000 square foot custom designed facility. There are seven fume hoods used in the laboratory for use when working with chemicals and samples that

have hazardous vapors. The ventilation system used in the volatiles department is a separate system to minimize cross contamination from other volatile chemicals used in the laboratory. There is a first aid kit, eye wash station, and chemical spill kits in each department. All gas tanks are chained to the walls of the two warehouse areas. All waste disposal containers are stored in the warehouses, with solvent waste stored in a flammable cabinet. All disposal activities are documented to include the date samples are disposed and the responsible person. Consult the Chemical Hygiene Plan for more detail. See Appendix 2 for a diagram of the laboratory.

14.9 Housekeeping

Each department is responsible for keeping their areas clean and in an orderly fashion. Samples are returned to storage after use, prep areas are cleaned daily, making sure that no residual chemicals or samples are left on the benchtop. Moreover, a cleaning service cleans the floors of the entire laboratory three times a week. Periodically, the laboratory may decide to wipe-sample the benchtops for any contamination that may adversely affect the data quality.

15. Record Storage and Electronic Data Procedures

All records, raw data for calibrations, samples, QC measures, and review forms, reports, logbooks, client correspondence, corrective action reports, performance evaluation sample results, audit reports, obsolete procedures, records pertaining to all suppliers of supplies and support, and any other forms of information generated at Great Lakes Environmental are archived for a minimum of 5 years (as of 12/11/00). All of these records are stored in bankers boxes with labels indicating their contents. A record management system is in place to control the access of the records. All the information and records generated by Great Lakes Analytical are retained for 5 years (as of 12/11/00).

In the event that Great Lakes Analytical merges with another business, or goes out of business, the laboratory will send notification to each client. The client will then have an opportunity to instruct the laboratory as to what to do with their analytical records. If they do not respond within one month of the notification, it will be assumed that the records are not desired and will therefore be disposed if alternate storage is not available.

Most of the work performed at Great Lakes Analytical involves the use of automated equipment and computer software. All computer and automated equipment is maintained to ensure proper functioning and provide environmental and operating conditions necessary to maintain the integrity of calibration and test data. Hardcopies of all data generated by automated equipment, data systems and computer software are kept on file and reviewed for completeness. Electronic data is organized on the local area network drive or PC harddrives by use of designated directories and file names (ex., the directory names for raw data are the analysis date; reports are stored by project number). The computer network system at Great Lakes Analytical is a secure system. Access to all information on the network, including analysis data, reports, invoicing, and accounting data, requires a password. This prevents unauthorized access to, and the unauthorized amendment of, computer records. Write-protected backups of all computer records are performed daily. All of these described procedures preserve the integrity of data, including integrity of data entry or capture, data storage, data transmission, and data processing. For more information on these issues, refer to the SOP for The Maintenance and Administration of the Laboratory Information Management System and the SOP on Data Review.

16. GLOSSARY TERMS

Acceptance limits: The data quality limits specified for analytical method performance.

Accuracy: A measure of the degree of agreement between an observed value generated by a specific procedure and a true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations.

ASTM: The American Society for Testing and Materials, West Conshohocken, PA, a non-for-profit, voluntary standards development system.

Analyte: A chemical element, chemical compound, or property.

Analyzed reagents (AR): Chemicals analyzed for impurities where the level of impurities is reported in accordance with specifications of the Committee on Analytical Reagents of the American Chemical Society.

Analytical standard: A solution of a compound or a mixture of compounds of known purity in an appropriate solvent used to prepare calibration standards. An analytical standard may be traceable to NIST standard reference materials.

Audit: A thorough, systematic, qualitative examination of a laboratory for compliance with state agency certification requirements, including but not limited to an examination of any of the following: facilities, equipment, personnel, training, procedures, documentation, record keeping, data verification, data validation, data, management, data reporting or any aspect of the laboratory's activities which affect the laboratory's ability to meet the state agency's conditions for accreditation.

Batch: One to 20 environmental samples of the same matrix that are prepared together with the same process and personnel, using the same lot of reagents with a maximum time between the start of processing of the first sample and the start of processing of the last sample being 24 hours.

Bias: The systematic or persistent distortion of a measurement system that causes errors in one direction (the expected sample measurement is different from the true value).

Blind sample: A sub sample for analysis with a composition known to the submitter that is used to test the analyst's, analyst-in-training's, or technician's proficiency in the execution of the measurement system. The analyst, analyst-in-training, or technician may know the identity of the sample but not its composition. The laboratory management may know the identity and composition of the blind sample.

Calibration: initial calibration.

Calibration blank: A volume of distilled or deionized water containing the same reagents, solvents, acids or preservatives contained in the calibration standards. The calibration blank is used to determine the response of the instrument to the zero concentration of an analyte of interest.

Calibration standard: A solution of an analyte or mixture of analyses of known purity in an appropriate solvent used to calibrate the analytical instrument response with respect to analyte concentration.

Certification: accreditation; the issuance by a state agency of certificates of competency to laboratories meeting the minimum standards established by the state agency. Accreditation is not a guarantee of the validity of the data generated by the accredited laboratory.

Certified laboratory: An accredited laboratory.

Confidence interval: The range of values, calculated from an estimate of the mean and standard deviation, which is expected to include the population mean with a stated level of certainty.

Continuing calibration verification (CCV) check: The analysis of a continuing calibration verification check standard to determine the state of calibration of an instrument between recalibrations.

Continuing calibration verification check standard: A solution of an analyte or mixture of analytes of known purity in an appropriate solvent used to perform the continuing calibration verification check. The source of the analyte may be the same as the source of the calibration standards source or it may be a second source.

Controlled access storage: A refrigerator, cooler, rooms or building in which samples are held and from which samples may be removed only by authorized laboratory personnel.

Corrective action: An action taken by the laboratory to eliminate or correct the causes of an exiting nonconformance in order to prevent the recurrence of the nonconformance.

Corrective action plan: A plan of corrective actions.

Document: Any written or pictorial information describing, defining, specifying, reporting, or certifying any activities, requirements, procedures or results.

Drinking Water: Water used or intended for uses potable water.

Drinking water analyses: analyses performed on water used or intended for use as potable water.

Drinking water sample data: analytical results generated by drinking water analysis.

Environmental analyses: Measurement information results generated through the analyses of environmental samples.

Environmental samples: samples, excluding any laboratory generated quality control samples such as matrix spikes, duplicates, and laboratory control samples, for which the laboratory analytical results will be reported.

Environmental sample data: Measurement data generated through the analysis of environmental samples.

Equipment Blank: An organic-free aqueous solution that is opened in the field, poured appropriately over and through the sample collection device, collected in a sample container and returned to the lab as a sample. Equipment blanks are a check of sampling device cleanliness.

Field Blank: An organic-free aqueous solution that is transferred from one preserved vessel to another at the sampling site. This serves as a check on reagent and environmental contamination.

Initial calibration: The analyses of calibration standards for a series of different specified concentrations of an analyte of interest used to define the linearity and dynamic range of the response of the instrument to an analyte.

Initial calibration verification (ICV): Analysis of an initial calibration verification check standard to determine the state of calibration of an instrument before sample analysis is initiated.

Initial calibration verification check standard: A solution of an analyte or mixture of analytes of known purity in an appropriate solvent used to perform the initial calibration verification check.

Initial demonstration of method performance (IDMP) study: The procedures performed by an analyst that insure that the analyst does not analyze unknown samples via a new or unfamiliar method prior to obtaining experience.

Inorganic: All parameters not included in organic parameters.

Internal Standard: A specific standard added to the sample or extract prior to analysis. The responses for the target compounds are compared to the responses of this standard.

Laboratory: A facility that is equipped and used for the testing of samples. A laboratory with a main facility and an annex in the same city as the main facility and within 5 miles of the main facility may be considered one laboratory.

Laboratory control sample: An uncontaminated sample matrix with known quantities of analytes. The analytes shall be obtained from a second source. The laboratory control sample is analyzed exactly like a sample to determine whether the measurement system is performing as expected and to determine whether the laboratory is capable of making accurate and unbiased measurements.

Linear calibration range: Linear dynamic range

Linear dynamic range: The range of concentration over which the analytical system exhibits a linear relationship between the amount of material introduced into the instrument and instrument's response,

Litigation sample: A sample, knowingly analyzed by the laboratory, for possible legal action.

Matrix: The predominant material of which the sample to be analyzed is composed. Sample matrices are:

Aqueous: any aqueous sample other than drinking water, potable water, or saline or estuarine Waters;

Drinking water: water used or intended for use as potable water;

Non-aqueous liquid: any organic fluid with <15% settleable solids;

Saline or estuarine water: any aqueous sample from an ocean or estuary.

Solids: soils, sediments, sludges and other matrices with >15% settleable solids

Chemical waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Matrix spike: an aliquot of matrix fortified (spike) with known quantities of specific analytes and subjected to the entire analytical procedure in order to determine the effect of the matrix on an approved test method's recovery test method.

Matrix spike duplicate: a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method.

Method: a procedure or technique for performing an activity (for example preparation and sample analysis).

Method blank: a sample which does not contain an analyte of interest above an acceptable level and which is processed simultaneously with and under the same conditions as samples being analyzed for analytes of interest.

Method detection limit (MDL): the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

Megohm-cm: megohm-centimeter

mg: milligram

emhas/cm: microhas per centimeter

Quality control acceptance limits: the statistically determined or approved test method specified limits within which a single measurement, quality control data point, series of measurements or series of quality control data points will fall when the analytical process is producing data of satisfactory quality.

Quality control chart: a graphical plot of data points used to demonstrate statistical control and monitor a measurement process. The charts have a vertical scale plotted in units of the analytical results, a horizontal scale in units of time or sequence of results, and lines within which or around which the data points are expected to lie.

Quality control check sample: an aliquot of method blank fortified with a solution of the analytes of interest of known concentration obtained from an outside source. The quality control check sample is used to check either laboratory or instrument performance.

Quality control procedures: the activities used to measure and monitor the accuracy and reliability of an analytical procedure or method.

Quantitating: the arithmetic process of determining the amount of analyte in a sample.

Reagent Grade: Analytical Reagent (AR) Grade, ACS Reagent Grade and Reagent Grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

Replicate: two or more equal aliquots taken from the same sample container and analyzed independently for the same constituent.

Sample tracking: an unbroken trail of accountability that ensures the physical security of samples, data, and records.

Sample duplicate: two equal aliquots taken from the same sample container and analyzed independently for the same constituent.

Second source: a different vendor or manufacturer or different lots from the same vendor or manufacturer.

Spike concentration: a specified amount of an analyte of interest in a matrix spike, laboratory control sample or quality control check sample.

Stable: resistant to displacement or change.

Standard operating procedure (SOP): a written laboratory specific document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Standard methods: Standard Methods for the Examination of Water and Wastewater, 18th edition, 1992

Statistical outlier test: a mathematical process for determining that an observation is unusually large or small relative to the other values in a data set.

Surrogate: an organic compound which is similar to the analytes of interest in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

Test: a technical operation that consists of the determination of one or more characteristics or performances of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure.

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, usually international or national standards, through an unbroken chain of comparisons.

Trip Blank: An organic-free aqueous solution that is transported to the sampling site and returned to the laboratory without being opened to serve as a check on contamination originating from sample transport, shipping and site conditions.

True value: the accepted or actual value of the quantity being measured.

USEPA: the United States Environmental Protection Agency.

USEPA Water Pollution (WP) Performance Evaluation Study: a performance evaluation program sponsored by the USEPA in which participation may be established by contracting the Illinois Environmental Protection Agency, Bureau of Water, Compliance Assurance, PO Box 19276, Springfield, Illinois 62794-9276

USEPA Water Supply (WS) Performance Evaluation Study: a performance evaluation program sponsored by the USEPA in which participation may be established by contacting the Illinois Environmental Protection Agency, Division of Springfield, Illinois 62794-9276

Validation: confirmation by examination and provision of objective that the particular requirements for a specific intended use are fulfilled. Validation is the process of examining a sample result to determine conformance with users' needs.

Verification: confirmation by examination of and provision of objective evidence that specified requirements has been fulfilled.

17. GREAT LAKES ANALYTICAL'S SCOPE OF TESTS AND PROCEDURES

MASS SPECTROSCOPY

<u>Test Category</u>	<u>Source Method</u>	<u>GLA SOP Code</u>
Volatile Organics by GC/MS	624/8260B	GLA-8260-KP
Semi-Volatile Organics by GC/MS	625/8270C	GLA-8270-KP

CHROMATOGRAPHY

Aromatic Volatile Organics	601/8021B	GLA-8021-KP
Polychlorinated Biphenyl's	608/8082	GLA-8082-KP
Organochlorine Pesticides	608/8081A	GLA-8081-KP
Semivolatile Extraction & Cleanup Procedures	3500B/3510C/3550B 3580A/3620B/3640A 3660B/3665A	GLA-3500-KP
Toxicity Characteristic Leaching Procedure	1311	GLA-1311-KP (plus the analysis SOP)
Synthetic Precipitation Leaching Procedure	1312	GLA-1312-KP (plus the analysis SOP)

LEAKING UNDERGROUND STORAGE TANK (LUST) ANALYSES

Gasoline Range Organics	8015M	GLA-GRO-KP
Diesel Range Organics	8015M	GLA-DRO-KP
Total Recoverable Petroleum Hydrocarbons	418.1	GLA-418.1-KP

Bibliography

United States Environmental Protection Agency, 1996. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, Third Edition. Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency, 1983. Methods for the Chemical Analysis of Water and Wastes. EPA 600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

United States Environmental Protection Agency, 1996. Methods for the Determination of Organic Compounds in Drinking Water. EPA 600/4-88/039, Revision 2.0. Office of Research and Development, Washington, D.C.

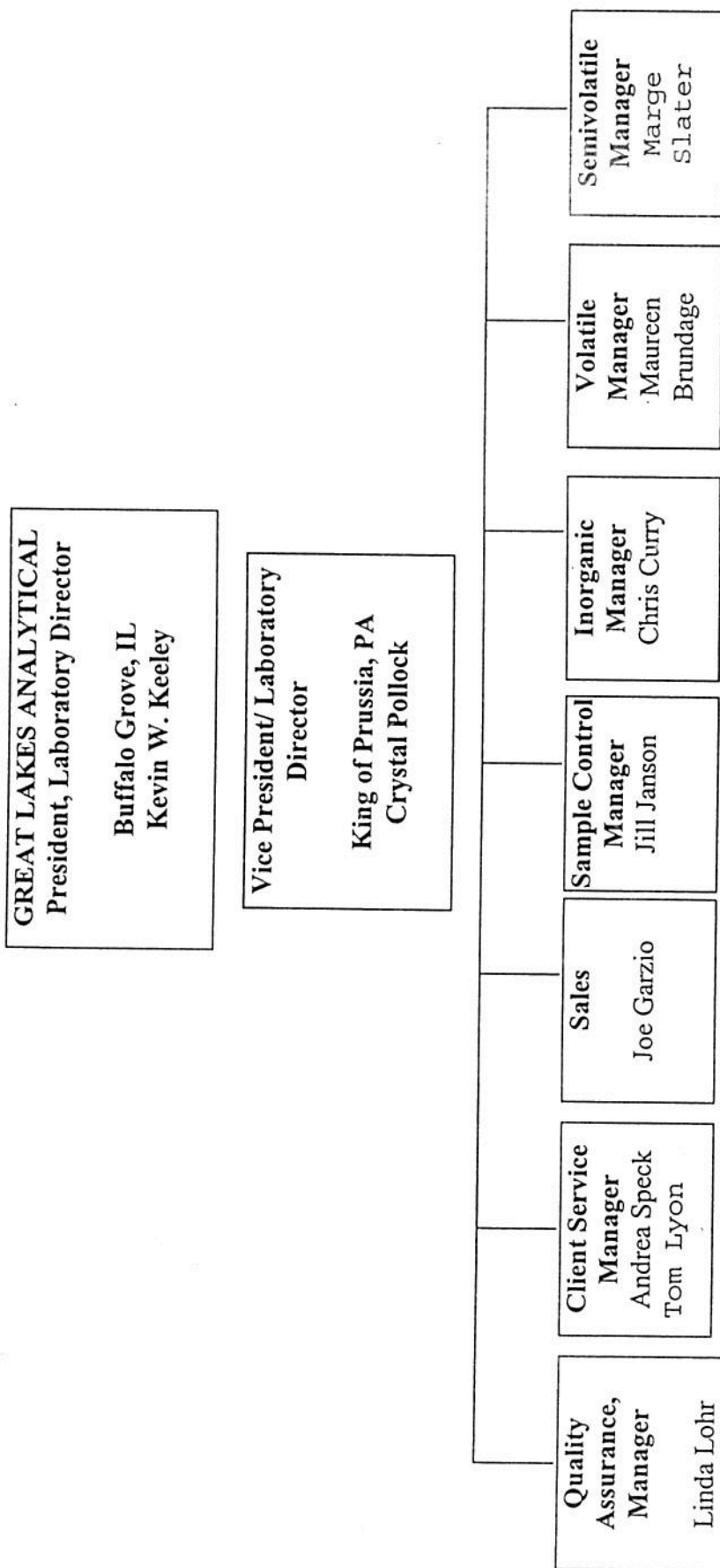
American Public Health Association, 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. 1015 Fifteenth Street NW, Washington, DC.

United States Environmental Protection Agency, 1997. Manual for the Certification of Laboratories Analyzing Drinking Water. EPA 815-B-97-001, 4th Edition. Office of Water, Ground Water, and Drinking Water, Technical Support Center, Cincinnati, OH.

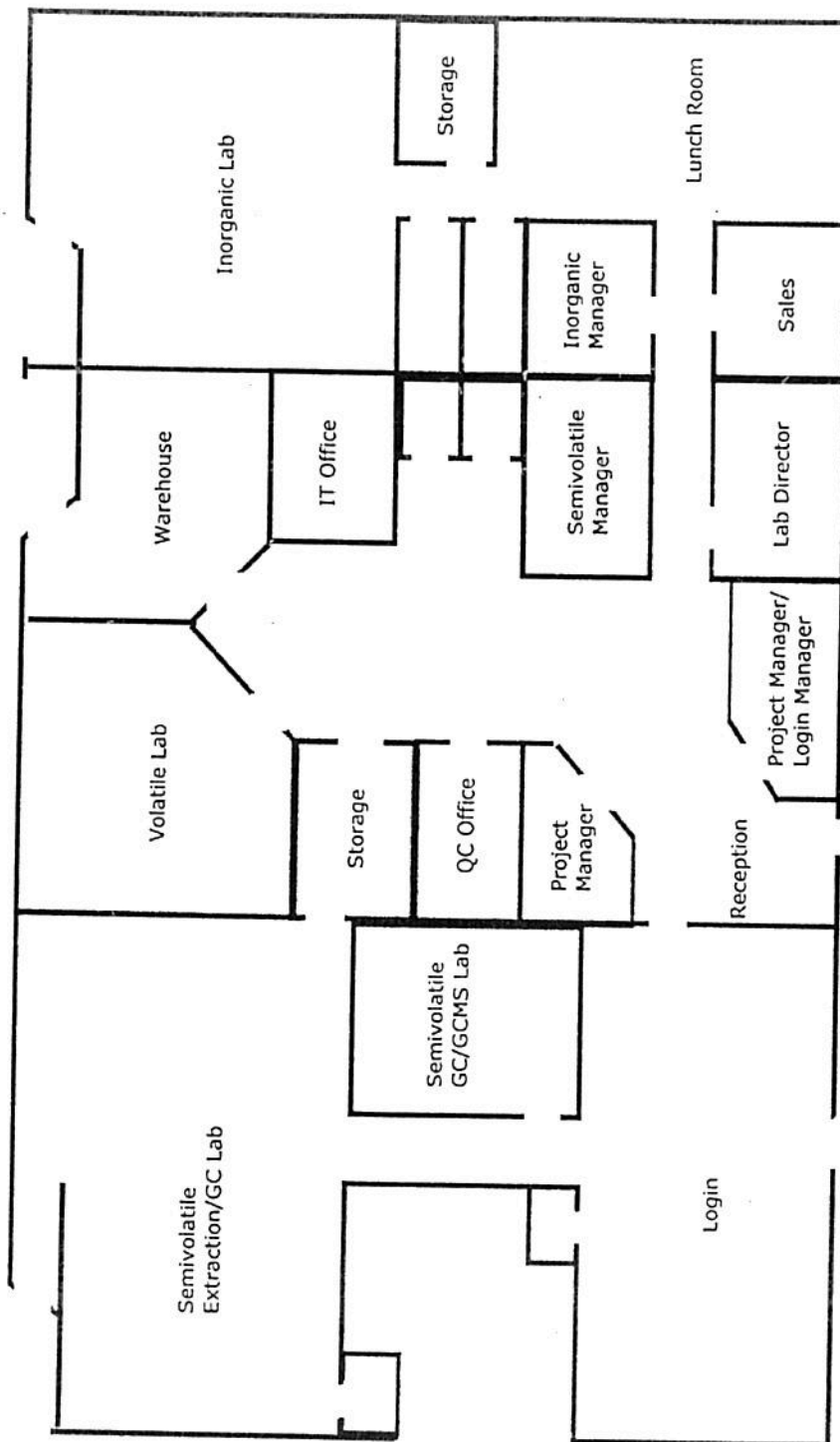
Illinois Environmental Protection Agency, 1998. Accreditation of Laboratories for Drinking Water, Wastewater, and Hazardous Waste Analysis. Title 35, Subtitle A, Chapter II, Part 186. State of Illinois Rules and Regulations, Springfield, IL.

Various standard operating procedures written by Great Lakes Analytical (See Section 17).

Appendix 1.
Laboratory Organizational Chart



Appendix 2. Laboratory Diagram



Appendix 3. Chain of Custody Report



1000 W. 1st Ave.
P.O. Box 1000
Trenton, NJ 08646
Tel: (609) 392-1234
Fax: (609) 392-1234

CHAIN OF CUSTODY REPORT

Client:		Bill To:		1st DAY		2nd DAY		3rd DAY		4th DAY		5th DAY		6th DAY		7th DAY		8th DAY		9th DAY		10th DAY	
Address:		Address:		DATE RESULTS NEEDED		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT		TEMPERATURE UPON RECEIPT	
Report To:		State & Program:		Phone #		Fax #		Phone #		Fax #		Phone #		Fax #		Phone #		Fax #		Phone #		Fax #	
Project:		Project:		Project:		Project:		Project:		Project:		Project:		Project:		Project:		Project:		Project:		Project:	
Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:		Sampler:	
NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #		NO Chain #	
FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION		FIELD ID, LOCATION	
1		1		1		1		1		1		1		1		1		1		1		1	
2		2		2		2		2		2		2		2		2		2		2		2	
3		3		3		3		3		3		3		3		3		3		3		3	
4		4		4		4		4		4		4		4		4		4		4		4	
5		5		5		5		5		5		5		5		5		5		5		5	
6		6		6		6		6		6		6		6		6		6		6		6	
7		7		7		7		7		7		7		7		7		7		7		7	
8		8		8		8		8		8		8		8		8		8		8		8	
9		9		9		9		9		9		9		9		9		9		9		9	
10		10		10		10		10		10		10		10		10		10		10		10	
11		11		11		11		11		11		11		11		11		11		11		11	
12		12		12		12		12		12		12		12		12		12		12		12	
13		13		13		13		13		13		13		13		13		13		13		13	
14		14		14		14		14		14		14		14		14		14		14		14	
15		15		15		15		15		15		15		15		15		15		15		15	
16		16		16		16		16		16		16		16		16		16		16		16	
17		17		17		17		17		17		17		17		17		17		17		17	
18		18		18		18		18		18		18		18		18		18		18		18	
19		19		19		19		19		19		19		19		19		19		19		19	
20		20		20		20		20		20		20		20		20		20		20		20	
21		21		21		21		21		21		21		21		21		21		21		21	
22		22		22		22		22		22		22		22		22		22		22		22	
23		23		23		23		23		23		23		23		23		23		23		23	
24		24		24		24		24		24		24		24		24		24		24		24	
25		25		25		25		25		25		25		25		25		25		25		25	
26		26		26		26		26		26		26		26		26		26		26		26	
27		27		27		27		27		27		27		27		27		27		27		27	
28		28		28		28		28		28		28		28		28		28		28		28	
29		29		29		29		29		29		29		29		29		29		29		29	
30		30		30		30		30		30		30		30		30		30		30		30	
31		31		31		31		31		31		31		31		31		31		31		31	
32		32		32		32		32		32		32		32		32		32		32		32	
33		33		33		33		33		33		33		33		33		33		33		33	
34		34		34		34		34		34		34		34		34		34		34		34	
35		35		35		35		35		35		35		35		35		35		35		35	
36		36		36		36		36		36		36		36		36		36		36		36	
37		37		37		37		37		37		37		37		37		37		37		37	
38		38		38		38		38		38		38		38		38		38		38		38	
39		39		39		39		39		39		39		39		39		39		39		39	
40		40		40		40		40		40		40		40		40		40		40		40	
41		41		41		41		41		41		41		41		41		41		41		41	
42		42		42		42		42		42		42		42		42		42		42		42	
43		43		43		43		43		43		43		43		43		43		43		43	
44		44		44		44		44		44		44		44		44		44		44		44	
45		45		45		45		45		45		45		45		45		45		45		45	
46		46		46		46		46		46		46		46		46		46		46		46	
47		47		47		47		47		47		47		47		47		47		47		47	
48		48		48		48		48		48		48		48		48		48		48		48	
49		49		49		49		49		49		49		49		49		49		49		49	
50		50		50		50		50		50		50		50		50		50		50		50	
51		51		51		51		51		51		51		51		51		51		51		51	
52		52		52		52		52		52		52		52		52		52		52		52	
53		53		53		53		53		53		53		53		53		53		53		53	
54		54		54		54		54		54		54		54		54		54		54		54	
55		55		55		55		55		55		55		55		55		55		55		55	
56		56		56		56		56		56		56		56		56		56		56		56	
57		57		57		57		57		57		57		57		57		57		57		57	
58		58		58		58		58		58		58		58		58		58		58		58	
59		59		59		59		59		59		59		59		59		59		59		59	
60		60		60		60		60		60		60		60		60		60		60		60	
61		61		61		61		61		61		61		61		61		61		61		61	
62		62		62		62		62		62		62		62		62		62		62		62	
63		63		63		63		63		63		63		63		63		63		63		63	
64		64		64		64		64		64		64		64		64		64		64		64	
65		65		65		65		65		65		65		65		65		65		65		65	
66		66		66		66		66		66		66		66		66		66		66		66	
67		67		67		67		67		67		67		67		67		67		67		67	
68		68		68		68		68		68		68		68		68		68		68		68	
69		69		69		69		69		69		69		69		69		69		69		69	
70		70		70		70		70		70		70		70		70		70		70		70	
71		71		71		71		71		71		71		71		71		71		71		71	
72		72		72		72		72		72		72		72		72		72		72		72	
73		73		73		73		73		73		73		73		73		73		73		73	
74		74		74		74		74		74		74		74		74		74		74		74	
75		75		75		75		75		75		75		75		75		75		75		75	
76		76		76		76		76		76		76		76		76		76		76		76	
77		77		77		77		77		77		77		77		77		77		77		77	
78		78		78		78		78		78		78		78		78		78		78		78	
79		79		79		79		79		79		79		79		79		79		79		79	
80		80		80		80		80		80		80		80		80		80		80		80	
81		81		81																			

Appendix 4. Sample Acceptance Policy

All samples received by Great Lakes Analytical for testing must include the following to ensure complete sample tracking and fulfillment of method specific requirements:

- Some form of chain of custody (COC) report must accompany each sample or group of samples received by the laboratory. This report must include, at a minimum: sample identifications; location; date and time of collection; collector's name; preservative added; sample matrix type; and any special remarks/requests. If a COC is not available at the time of sampling, notes need to be kept in the field, and then transferred onto a COC provided at the laboratory.
- All sample containers must have a label that reflects the sample's unique identification and any preservative in the container. Any documentation on the label should be performed with the use of indelible ink.
- The container used for sampling should be appropriate for the analysis requested for the sample based on method requirements.
- The laboratory should receive samples with the maximum possible amount of the hold time left for testing.
- An adequate volume of sample needs to be submitted for the analyses requested.
- An effort should be made to preserve samples in the field using method specified bottles and preservatives and to cool the samples immediately after sampling and during transport to the laboratory.

Samples received by the laboratory that do not include the above information or show signs of damage or contamination are kept in a "hold" status until the receipt issues are resolved with the client. Failure to meet the above requirements may result in data that is qualified.

Appendix 5. Great Lakes Analytical Footnotes

>200	Did not flash below 200F
A	The concentration of the analyte in the sample is characteristic of a laboratory artifact.
B	The blank associated with this sample contained (custom value) of this compound.
DILN	Due to matrix interference and or sample dilution the detection limits for this sample have been elevated.
FAIL	Free liquids present
G1	The matrix QC recoveries associated with this sample were above the laboratory's established acceptance criteria.
G10	This sample was filtered in the laboratory for dissolved metals.
G11	This analysis was subcontracted to (custom value)
G12	This sample was originally run within hold time, it was rerun for carryover contamination or QC purposes outside of the method specified hold time.
G13	This sample was diluted due to the high concentration of the interfering element: (custom value).
G2	The matrix QC recoveries associated with this sample were below the laboratory's established acceptance criteria.
G3	The laboratory control spike recoveries associated with this sample were above the laboratory's established acceptance criteria.
G4	The laboratory control spike recoveries associated with this sample were below the laboratory's established acceptance criteria.
G5	This sample was received past the method specified hold time.
G6	This sample was extracted past the method specified hold time
G7	This sample was analyzed past the method specified hold time
G8	This sample was received without the proper preservatives required by the method.
G9	This sample was originally analyzed within hold time, the dilution for this compound was run out of the method specified hold time.
I3	The oxygen depletion did not meet the method criteria for optimal results.
ICP	Due to the high concentration of this analyte this sample was analyzed by ICP method 6010B.
J	The reported concentration for this analyte is an estimated value. The reported concentration is above the method detection limits, but below the reporting limit .
O2	One or more internal standard recoveries were below the method specified acceptance criteria.
O3	One or more internal standard recoveries were above the method specified acceptance criteria.
O4	One or more surrogate recoveries were below the laboratory's established acceptance criteria.
O5	One or more surrogate recoveries were above the laboratory's established acceptance criteria.
O6	This sample was analyzed by method 8260B
O7	The reporting limits for this sample have been raised due to low sample weight or weight/methanol volume ration.
O8	The preservative in the sample produced ketones, the reporting limits have been raised.
O9	One or more SPCCs has not met its minimum response factor.
10	This compound was above the method control limits in the check standard associated with this sample.
11	This compound was below the method control limits in the check standard associated with this sample.
12	This sample contained chlorine and was not de-chlorinated before analysis.
PASS	No free liquids
PRES	Present
PRLM	Preliminary results

The following footnotes appear on all reports:

DET	Analyte Detected
ND	Analyte Not Detected at or above the reporting limit.
NR	Not Reported
Dry	Sample results reported on a dry weight basis.
The reporting limit is based on a calculation derived from the Method Detection Study.	
The reporting limit may not represent the lowest point on the calibration curve.	
State Certifications are listed as a footnote	

Appendix 6.

Great Lakes Analytical ETHICS AND DATA INTEGRITY AGREEMENT

I, _____ (print name), state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Great Lakes Analytical. I understand that the company's mission is:

We are a client driven environmental testing laboratory producing superior quality data in a timely manner. By providing our services to environmental decision makers we help ensure a cleaner environment.

We are committed to professional development, a safe workplace, and ethical practices. We work to maximize the potential of our staff and the strength of our team.

I understand that it is critical for our long-term success that every employee aligns with all company core values.

I agree that in the performance of my duties for Great Lakes Analytical and its clients, I shall conform to the following ethics standards and will report immediately to the Quality Assurance Manager and the appropriate supervisor any information concerning misrepresentation of analytical data that includes, but is not limited to:

- Altering an instrument computer or clock for the purposes of backdating results;
- Altering the contents of logbooks and/or data sheets to misrepresent data;
- Misrepresentation of an analyst's identity;
- Changing raw data documents with correction fluid;
- Preparation and submittal of 'fake' data packages;
- Illegal calibration techniques such as peak shaving, setting fraudulent integrator parameters, use of computer macros that alter QC results;
- Changing reported results without proper documentation and approval;
- Altering injection volumes for calibration and misrepresenting the true values;
- Failure to comply with standard operating procedures or methods in order to take 'short cuts' that may affect analytical results;
- Any attempt to misrepresent data or events as they actually occur in the course of data production, review, or reporting;
- Disposing of or deleting electronic data files or hardcopy of raw data which have not been archived.
- Engaging in any practice that ultimately misrepresents data or narratives in any way.

I will not knowingly participate in any such activity and will not tolerate unethical practices by others. I understand that confidentiality will be strictly enforced by Great Lakes Analytical when dealing with these matters. As a further extension of my commitment to this program, I am responsible for seeking approval from my Supervisor to report results that may deviate from standard operating procedures, methods, or industry standard practices. This approval shall be documented through the Corrective Action Program (See SOP; GLA QA CAP-BG). Any such reporting of data will include a laboratory narrative or report flags.

I will not perform work in the laboratory under commercial, financial, or other pressures which might adversely affect the quality of my work.

If I am unsure of how to properly handle data generated by me, I am responsible for seeking advice and approval from the Quality Assurance Manager or the appropriate supervisor. I agree to inform the Quality Assurance Manager and the appropriate supervisor of any accidental reporting of non-authentic data by others or myself within 24 hours of discovery.

I understand that if I knowingly participate in any such prohibited activity, I will be subject to serious disciplinary action that may include immediate termination by Great Lakes Analytical. I also understand that I face individual suspension and debarment from all Federal programs should I be convicted of such practices. I understand that suspension and debarment from all Federal programs affects my ability to work in the environmental field, as well as, any other professions where government funding or loans may be involved. I understand the most serious consequence of unethical conduct can be imprisonment if convicted.

My signature affirms my understanding of the consequences of violating this '*ETHICS AND DATA INTEGRITY AGREEMENT*' and my commitment to its intent. My signature further affirms that I have received formal training on this topic.

(Signature)

(Date)

Return to the Human Resources Department for placement in each personnel file.

APPENDIX C

EDQ DATA VALIDATION QUALIFICATION PACKAGE

Environmental Data Quality, Inc. (EDQ) provides support services for field and analytical quality assurance, and environmental chemistry. EDQ was founded in response to the following factors:

- The growing need to provide clients with field and analytical data that is of the highest technical quality for its intended purpose;
- The need for risk controls to avert the costly consequences of insufficient and/or poor quality data; and
- The need to provide guidance support to clients regarding sampling and analysis procedures and protocols in response to regulatory compliance requirements.

EDQ provides services in the following key areas:

- Analytical Services Procurement and Management
- Quality Assurance Project Plan Development and Implementation
- Analytical Data Validation
- Analytical Database Management
- Corporate Environmental Laboratory Audit Programs
- Field Audits

While there are a number of firms that provide quality assurance services similar to those presented above, EDQ stands out as a company able to develop innovative and cost-effective programs designed to meet the needs of the client. Examples of these client-focused services include:

Expertise that Translates to Lower Costs for the Client

- EDQ's experienced personnel provide guidance and education to clients. EDQ can work with the client in disciplines that cover the spectrum of analytical/sampling scheme development to data interpretation. EDQ's expertise provides the means to negotiate with regulatory agencies. EDQ has a working knowledge of the requirements for EPA Regions I, II, III, IV, and V; a number of State Agencies; and the DOD/DOE requirements for Government Agencies such as USAEC, USACE, NFESC, and AFCEE. Because of this knowledge, plans and reports can be submitted to regulatory agencies and typically approved with minimal comments.

Data Validation and Other Quality Assurance Support Services are Geared Toward Program or Project Objectives

- EDQ can meet all of the client's needs for sampling, analysis, and quality assurance support, through "one stop shopping", resulting in convenience for the client. EDQ can also provide support for specific quality assurance support tasks. The use of EDQ for quality assurance support will free the client project manager to focus on other areas of the project that needs his or her attention.

EDQ is an independent, woman-owned, small minority business enterprise.

EDQ's staff consists of Quality Assurance (QA) chemists and data management technicians, who perform data validation and other quality assurance support functions. EDQ staff have performed numerous analytical data validation reviews, and have authored numerous Quality Assurance Project Plans for CERCLA, RCRA, state-led, DOD, DOE-led investigations, as well as for litigation support and due diligence projects.

EDQ performs data validation using state and federal guidelines. Because EDQ's QA chemists are usually involved with a project from Work Plan and QAPjP development, they are familiar with Project Data Quality Objectives (DQOs). For projects, where EDQ is not involved in Work Plan or QAPjP development, our QA chemists familiarize themselves with project DQOs prior to beginning data validation. Review of the project QAPjP, conference calls, client meetings, etc accomplish this. Chemists can therefore, focus on evaluating the usability of the analytical data for the purpose for which it was collected.

EDQ has extensive experience in the validation of organic (including dioxin), inorganic, and radiochemistry data, including experience in validating TCL/TAL, PPL, Appendix IX, and wet chemistry data analyzed according to numerous methodologies. Validation has been performed for data generated for projects governed by USEPA Regions I, II, III, and V; State Agencies PADEP, NJDEP, and Ohio EPA; as well as USAEC, USACE, NFESC, and AFCEE.

EDQ's data validation is performed according to the general guidance provided in the "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis," USEPA 9/94; the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," USEPA 2/94; or regional or state modifications to the USEPA guidance documents. The data validation guidance documents were prepared specifically for validation of CLP TCL/TAL analyses. EDQ uses professional judgment and in-house guidance for non-CLP data review.

EDQ provides an independent assessment of the quality of analytical data. Because EDQ is independent of the sampling and analysis process, the validation and the resulting report are objective and legally defensible.

SHAWNE M. RODGERS, PRESIDENT

Education:

B.S., Chemistry, University of Pittsburgh, 1986.

Continuing Education:

Certified as having met OSHA Hazardous Waste Requirements under 29 CFR 1910.120. Updated annually.

Experience:

Ms. Rodgers serves as President of EDQ, and is responsible for all management decisions and directing technical and client programs. Ms. Rodgers has over sixteen years of experience in the areas of environmental chemistry, data validation, and environmental quality assurance. She specializes in development of field procedures for the collection of representative ground water, surface water, soil, air and other multi-media samples, and the interpretation of organic and inorganic data. Ms. Rodgers previously served as Quality Assurance Manager for a global environmental consulting firm, and was responsible for directing laboratory subcontractor analytical services, special analytical projects, field and laboratory quality assurance/quality control programs, and analytical data validation services. She managed and directed a staff of quality assurance chemists whose primary duties were field quality assurance procedure development, analytical data management and analytical data validation. While under her direction, the staff of chemists doubled in size, with an average backlog of over \$951 thousand per month. Ms. Rodgers also served as a project manager at the company, responsible for overseeing the implementation of work scope, schedule and budget.

Ms. Rodgers also worked as a Quality Assurance Chemist with the USEPA Region I Environmental Services Assistance Team (ESAT). This group provided data validation services for EPA Region I CERCLA investigations and provided oversight of Region I contractors. During this employment, Ms. Rodgers was responsible for Quality Assurance Project Plan (QAPP) review, development of Special Analytical Services (SAS) specifications, and oversight of Region I contractor SAS requests. Additionally, she was responsible for the development and implementation of data validation training workshops.

Ms. Rodgers also worked for several years at an environmental analytical laboratory. She has extensive practical experience performing inorganic

analyses. She also served as a quality assurance officer for the laboratory and was responsible for the development and implementation of the laboratory's in-house quality assurance/quality control program.

Ms. Rodgers has extensive experience in the validation of organic (including dioxin) and inorganic data generated according to numerous methodologies. She has extensive experience writing quality assurance project plans, developing analytical strategies, coordinating laboratory efforts, performing field and laboratory audits, and serving as a technical resource in matters requiring knowledge of environmental analytical methods and quality assurance requirements. She has a working knowledge of the requirements for EPA Regions I, II, III, IV, and V; a number of State Agencies, including NJDEP, PADEP, and NYSDEC; as well as USAEC, USACE, NFSC, and AFCEE. Ms. Rodgers has also authored twenty QAPPs for CERCLA sites and RCRA facilities in Pennsylvania, Maryland, Connecticut, Florida, Virginia, West Virginia, Ohio, Delaware, and for a risk assessment investigation performed in Europe. She has developed and conducted training programs to teach data validation procedures according to USEPA requirements.

Ms. Rodgers has audited over 30 laboratories for conformance with program requirements. She is familiar with data management procedures for storing, retrieving, and reporting field and analytical data.

Affiliations:

Society of Women Environmental Professionals - Philadelphia Chapter
Co-Chair and Co-Founder

American Chemical Society

Technology Council of Greater Philadelphia - Environmental Advisory
Board Member



CAROLINE ROWSHAN, QUALITY ASSURANCE CHEMIST

Education:


B.S., Chemistry Management, Widener University, 1990.

Experience:

Ms. Rowshan has over ten years experience in the field of environmental chemistry with an emphasis on analytical data validation and quality assurance. She has performed data validation for various clients related to CERCLA, RCRA, NJDEP and state-led site inspections and remediation investigations.

She has a working knowledge of the requirements for EPA Regions I, II, III, IV, and V; a number of State Agencies, such as NJDEP and PADEP; as well as USAEC, USACE, NFSC, and AFCEE.

Ms. Rowshan often serves as the lead chemist for projects requiring validation in accordance with the NJDEP guidance. She has been responsible for the validation of data generated in both full and reduced deliverable formats.



She has been responsible for the preparation of project data summary tables, validation support documentation, and Analytical Quality Assurance reports for over one hundred projects, involving hundreds of samples. She has experience in the protocols for volatile, semivolatile, pesticides/PCBs, herbicides, metals, and various wet chemistry analyses using CLP, SW-846, and 40 CFR Part 136 methodologies.

Ms. Rowshan has substantial practical experience with a premier environmental testing laboratory, performing CLP and non-CLP analyses on samples using GC/MS systems. She also participated in the development of various laboratory method Standard Operating Procedures and was responsible for the training of new chemists.

CHARLENE BUTLER, QUALITY ASSURANCE INFORMATION SPECIALIST

Education:

B.S., Computer Science, Lincoln University, 2001.

Continuing Education:

MCP, MCSE, and MCDBA Microsoft certifications. In-Progress

Experience:

Ms. Butler serves as EDQ's Quality Assurance Information Specialist, responsible for tracking of validation progress, creating of database reports for use by chemists conducting data validation reviews and implementation of the in-house database. She has also implemented electronic deliverable requirements for Navy, USACE, AFCEE, and industrial projects. Ms. Butler has significant knowledge of Microsoft Access, dBase, C++, HTML, and Java.

APPENDIX D

PADEP ACT 2 ACTION LIMITS

APPENDIX A
TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R	NR	
ACENAPHTHENE	83-32-9	2,200 G	3,800 S		3,800 S	3,800 S		3,800 S	3,800 S	
ACENAPHTHYLENE	208-96-8	2,200 G	6,100 G		16,000 S	16,000 S		16,000 S	16,000 S	
ACEPHATE	30560-19-1	76 G	300 G		7,600 G	30,000 G		76 G	300 G	
ACETALDEHYDE	75-07-0	19 N	52 N		1,900 N	5,200 N		19 N	52 N	
ACETONE	67-64-1	3,700 G	10,000 G		370,000 G	1,000,000 G		37,000 G	100,000 G	
ACETONITRILE	75-05-8	170 N	350 N		17,000 N	35,000 N		1,700 N	3,500 N	
ACETOPHENONE	98-86-2	3,700 G	10,000 G		370,000 G	1,000,000 G		3,700 G	10,000 G	
ACETYLAMINOFLUORENE, 2- (2AAF)	53-96-3	0.17 G	0.68 G		17 G	68 G		170 G	680 G	
ACROLEIN	107-02-8	0.055 N	0.12 N		5.5 N	12 N		0.55 N	1.2 N	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
ACRYLAMIDE	79-06-1	0.033 N	0.14 N		3.3 N	14 N		0.033 N		0.14 N
ACRYLIC ACID	79-10-7	2.8 N	5.8 N		280 N	580 N		280 N		580 N
ACRYLONITRILE	107-13-1	0.63 N	2.7 N		63 N	270 N		63 N		270 N
ALACHLOR	15972-60-8	2 M	2 M		200 M	200 M		2 M		2 M
ALDICARB	116-06-3	7 M	7 M		700 M	700 M		7,000 M		7,000 M
ALDRIN	309-00-2	0.0087 N	0.037 N		0.87 N	3.7 N		0.87 N		3.7 N
ALLYL ALCOHOL	107-18-6	49 N	100 N		4,900 N	10,000 N		4,900 N		10,000 N
AMINOBIHENYL, 4-	92-67-1	0.031 G	0.12 G		3.1 G	12 G		31 G		120 G
AMITROLE	61-82-5	0.7 G	2.8 G		70 G	280 G		700 G		2,800 G

All concentrations in µg/L

H = Lifetime health advisory level

R = Residential

G = Ingestion

NR = Non-Residential

N = Inhalation

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR	R	R	NR	NR	R	R	NR
AMMONIA	7664-41-7	30,000 H	30,000 H	3,000,000 H	3,000,000 H	3,000,000 H	3,000,000 H	30,000 H	30,000 H	30,000 H
AMMONIUM SULFAMATE	7773-06-0	2,000 H	2,000 H	200,000 H	200,000 H	200,000 H	200,000 H	2,000 H	2,000 H	2,000 H
ANILINE	62-53-3	2.8 N	5.8 N	280 N	280 N	580 N	580 N	2.8 N	2.8 N	5.8 N
ANTHRACENE	120-12-7	66 S	66 S	66 S	66 S	66 S	66 S	66 S	66 S	66 S
ATRAZINE	1912-24-9	3 M	3 M	300 M	300 M	300 M	300 M	3 M	3 M	3 M
BAYGON (PROPOXUR)	114-26-1	3 H	3 H	300 H	300 H	300 H	300 H	3,000 H	3,000 H	3,000 H
BENOMYL	17804-35-2	1,800 G	2,000 S	2,000 S	2,000 S	2,000 S	2,000 S	1,800 G	1,800 G	2,000 S
BENTAZON	25057-89-0	1,100 G	3,100 G	110,000 G	110,000 G	310,000 G	310,000 G	1,100 G	1,100 G	3,100 G
BENZENE	71-43-2	5 M	5 M	500 M	500 M	500 M	500 M	500 M	500 M	500 M

All concentrations in µg/L
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 R = Residential
 NR = Non-Residential
 N = Inhalation
 S = Aqueous solubility cap
 G = Ingestion

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
BENZIDINE	92-87-5	0.0029 G	0.011 G		0.29 G		1.1 G	2.9 G		11 G
BENZO(A)ANTHRACENE	56-55-3	0.9 G	3.6 G		11 S		11 S	11 S		11 S
BENZO(A)PYRENE	50-32-8	0.2 M	0.2 M		3.8 S		3.8 S	3.8 S		3.8 S
BENZO(B)FLUORANTHENE	205-99-2	0.9 G	1.2 S		1.2 S		1.2 S	1.2 S		1.2 S
BENZO(GH)PERYLENE	191-24-2	0.26 S	0.26 S		0.26 S		0.26 S	0.26 S		0.26 S
BENZO(K)FLUORANTHENE	207-08-9	0.55 S	0.55 S		0.55 S		0.55 S	0.55 S		0.55 S
BENZOIC ACID	65-85-0	150,000 G	410,000 G		2,700,000 S		2,700,000 S	150,000 G		410,000 G
BENZOTRICHLORIDE	98-07-7	0.051 G	0.2 G		5.1 G		20 G	51 G		200 G
BENZYL ALCOHOL	100-51-6	11,000 G	31,000 G		1,100,000 G		3,100,000 G	11,000 G		31,000 G

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	R	NR	R	R	NR
BENZYL CHLORIDE	100-44-7	0.87 N	3.7 N	87 N	87 N	370 N	87 N	370 N	
BHC, ALPHA-	319-84-6	0.1 G	0.41 G	10 G	10 G	41 G	100 G	410 G	
BHC, BETA-	319-85-7	0.37 G	1.4 G	37 G	37 G	100 S	100 S	100 S	
BHC, DELTA-	319-86-8	22 G	61 G	2,200 G	2,200 G	6,100 G	8,000 S	8,000 S	
BHC, GAMMA (LINDANE)	58-89-9	0.2 M	0.2 M	20 M	20 M	20 M	200 M	200 M	
BIPHENYL, 1,1-	92-52-4	1,800 G	5,100 G	7,200 S	7,200 S	7,200 S	7,200 S	7,200 S	
BIS(2-CHLOROETHYL)ETHER	111-44-4	0.13 N	0.55 N	13 N	13 N	55 N	13 N	55 N	
BIS(2-CHLORO-ISOPROPYL)ETHER	108-60-1	300 H	300 H	30,000 H	30,000 H	30,000 H	30,000 H	30,000 H	
BIS(CHLOROMETHYL)ETHER	542-88-1	0.00069 N	0.0029 N	0.069 N	0.069 N	0.29 N	0.069 N	0.29 N	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS					
		TDS ≤ 2500			TDS > 2500			TDS ≤ 2500			TDS > 2500		
		R	NR		R	NR		R	NR		R	NR	
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	6 M	6 M		290 S	290 S		290 S	290 S		290 S	290 S	
BISPHENOL A	80-05-7	1,800 G	5,100 G		120,000 S	120,000 S		120,000 S	120,000 S		120,000 S	120,000 S	
BROMACIL	314-40-9	80 H	80 H		8,000 H	8,000 H		80 H	80 H		80 H	80 H	
BROMOCHLOROMETHANE	74-97-5	90 H	90 H		9,000 H	9,000 H		90 H	90 H		90 H	90 H	
BROMODICHLOROMETHANE	75-27-4	100 M	100 M		10,000 M	1,000 M		100 M	100 M		100 M	100 M	
BROMOMETHANE	74-83-9	10 H	10 H		1,000 H	1,000 H		1,000 H	1,000 H		1,000 H	1,000 H	
BROMOXYNIL	1689-84-5	730 G	2,000 G		73,000 G	130,000 S		730 G	730 G		730 G	2,000 G	
BROMOXYNIL OCTANOATE	1689-99-2	80 S	80 S		80 S	80 S		80 S	80 S		80 S	80 S	
BUTADIENE, 1,3-	106-99-0	0.15 N	0.65 N		15 N	65 N		15 N	15 N		15 N	65 N	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
BUTYL ALCOHOL, N-	71-36-3	970 N	2,000 N		97,000 N	200,000 N		9,700 N	20,000 N	
BUTYLATE	2008-41-5	350 H	350 H		35,000 H	35,000 H		350 H	350 H	
BUTYLBENZENE, N-	104-51-8	1,500 G	4,100 G		15,000 S	15,000 S		1,500 G	4,100 G	
BUTYLBENZENE, SEC-	135-98-8	1,500 G	4,100 G		17,000 S	17,000 S		1,500 G	4,100 G	
BUTYLBENZENE, TERT-	98-06-6	1,500 G	4,100 G		30,000 S	30,000 S		1,500 G	4,100 G	
BUTYLBENZYL PHTHALATE	85-68-7	2,700 S	2,700 S		2,700 S	2,700 S		2,700 S	2,700 S	
CAPTAN	13-36-2	190 G	500 S		500 S	500 S		500 S	500 S	
CARBARYL	63-25-2	700 H	700 H		70,000 H	70,000 H		120,000 S	120,000 S	
CARBAZOLE	86-74-8	33 G	130 G		1,200 S	1,200 S		1,200 S	1,200 S	

All concentrations in µg/L

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	R	NR	R	R	NR
CARBOFURAN	1563-66-2	40 M	40 M	4,000 M	4,000 M	4,000 M	40 M	40 M	40 M
CARBON DISULFIDE	75-15-0	1,900 N	4,100 N	190,000 N	190,000 N	410,000 N	1,900 N	1,900 N	4,100 N
CARBON TETRACHLORIDE	56-23-5	5 M	5 M	500 M	500 M	500 M	50 M	50 M	50 M
CARBOXIN	5234-68-4	700 H	700 H	70,000 H	70,000 H	70,000 H	700 H	700 H	700 H
CHLORAMBEN	133-90-4	100 H	100 H	10,000 H	10,000 H	10,000 H	100 H	100 H	100 H
CHLORDANE	57-74-9	2 M	2 M	56 S	56 S	56 S	56 S	56 S	56 S
CHLORO-1,1-DIFLUOROETHANE, 1-	75-68-3	140,000 N	290,000 N	1,400,000 S	1,400,000 S	1,400,000 S	140,000 N	140,000 N	290,000 N
CHLORO-1-PROPENE, 3- (ALLYL CHLORIDE)	107-05-1	2.8 N	5.8 N	280 N	280 N	580 N	280 N	280 N	580 N
CHLOROACETOPHENONE, 2-	532-27-4	0.31 G	0.88 G	31 G	31 G	88 G	310 G	310 G	880 G

All concentrations in µg/L

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

R = Residential

NR = Non-Residential

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	NR	R	NR	R	NR
CHLOROANILINE, P-	106-47-8	150 G	410 G	15,000 G	41,000 G	150 G	410 G		
CHLOROBENZENE	108-90-7	100 M	100 M	10,000 M	10,000 M	10,000 M	10,000 M		
CHLOROBENZILATE	510-15-6	2.4 G	9.6 G	240 G	960 G	2,400 G	9,600 G		
CHLOROBUTANE, 1-	109-69-3	15,000 G	41,000 G	680,000 S	680,000 S	15,000 G	41,000 G		
CHLORODIBROMOMETHANE	124-48-1	100 M	100 M	10000 M	10000 M	10000 M	10000 M		
CHLORODIFLUOROMETHANE	75-45-6	100 H	100 H	10,000 H	10,000 H	100 H	100 H		
CHLOROETHANE	75-00-3	230 G	900 G	23,000 G	90,000 G	23,000 G	90,000 G		
CHLOROFORM	67-66-3	100 M	100 M	10,000 M	10,000 M	1,000 M	1,000 M		
CHLORONAPHTHALENE, 2-	91-58-7	2,900 G	8,200 G	12,000 S	12,000 S	2,900 G	8,200 G		

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500			R	NR
		R	NR	R	NR	R	NR		
CHLORONITROBENZENE, P-	100-00-5	37 G	140 G	3,700 G	14,000 G	37 G	140 G		
CHLOROPHENOL, 2-	95-57-8	40 H	40 H	4,000 H	4,000 H	40 H	40 H		
CHLOROPRENE	126-99-8	19 N	41 N	1,900 N	4,100 N	1,900 N	4,100 N		
CHLOROPROPANE, 2-	75-29-6	280 N	580 N	28,000 N	58,000 N	280 N	580 N		
CHLOROTHALONIL	1897-45-6	60 G	240 G	600 S	600 S	60 G	240 G		
CHLOROTOLUENE, O-	95-49-8	100 H	100 H	10,000 H	10,000 H	100 H	100 H		
CHLORPYRIFOS	2921-88-2	20 H	20 H	1,100 S	1100 S	20 H	20 H		
CHLORSULFURON	64902-72-3	1,800 G	5,100 G	130,000 S	130,000 S	1,800 G	5,100 G		
CHLOROTHAL-DIMETHYL (DACTHAL) (DCPA)	1861-32-1	400 H	400 H	500 S	500 S	500 S	500 S		

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR		R	NR		R	NR
CHRYSENE	218-01-9	1.9 S	1.9 S		1.9 S	1.9 S		1.9 S	1.9 S
CRESOL	1319-77-3	180 G	510 G		18,000 G	51,000 G		18,000 G	51,000 G
CRESOL, O- (METHYLPHENOL, 2-)	95-48-7	1,800 G	5,100 G		180,000 G	510,000 G		180,000 G	510,000 G
CRESOL, M (METHYLPHENOL, 3-)	108-39-4	1,800 G	5,100 G		180,000 G	510,000 G		1,800,000 G	2,500,000 S
CRESOL, P (METHYLPHENOL, 4-)	106-44-5	180 G	510 G		18,000 G	51,000 G		180,000 G	510,000 G
CRESOL, P-CHLORO-M-	59-50-7	180 G	510 G		18,000 G	51,000 G		180 G	510 G
CROTONALDEHYDE	4170-30-3	0.079 N	0.34 N		7.9 N	34 N		7.9 N	34 N
CROTONALDEHYDE, TRANS-	123-73-9	0.079 G	0.34 G		7.9 G	34 G		7.9 G	34 G
CUMENE	98-82-8	1,100 N	2,300 N		50,000 S	50,000 S		50,000 S	50,000 S

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR	R	NR	R	NR	R	R	NR
CYCLOHEXANONE	108-94-1	49,000 N	100,000 N	4,900,000 N	10,000,000 N	49,000 N	100,000 N	49,000 N	100,000 N	N
CYFLUTHRIN	68359-37-5	1 S	1 S	1 S	1 S	1 S	1 S	1 S	1 S	1 S
CYROMAZINE	66215-27-8	270 G	770 G	27,000 G	77,000 G	270 G	770 G	270 G	770 G	G
DDD, 4,4'-	72-54-8	0.62 N	2.7 N	62 N	160 S	62 N	160 S	62 N	160 S	S
DDE, 4,4'-	72-55-9	1.9 G	7.6 G	40 S	40 S	40 S	40 S	40 S	40 S	S
DDT, 4,4'-	50-29-3	1.9 G	5.5 S	5.5 S	5.5 S	5.5 S	5.5 S	5.5 S	5.5 S	S
DI(2-ETHYLHEXYL)ADIPATE	103-23-1	400 M	400 M	40,000 M	40,000 M	40,000 M	40,000 M	200,000 S	200,000 S	S
DIALATE	2303-16-4	2.5 N	10 N	250 N	1,000 N	250 N	1,000 N	250 N	1,000 N	N
DIAMINOTOLUENE, 2,4-	95-80-7	0.21 G	0.81 G	21 G	81 G	21 G	81 G	210 G	810 G	G

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	H	R	NR	R	NR	R
DIAZINON	333-41-5	0.6 H	0.6 H	60 H	60 H	0.6 H	0.6 H	0.6 H	0.6 H
DIBENZO(A,H)ANTHRACENE	53-70-3	0.09 G	0.36 G	0.6 S	0.6 S	0.6 S	0.6 S	0.6 S	0.6 S
DIBROMO-3-CHLOROPROPANE, 1,2-	96-12-8	0.2 M	0.2 M	20 M	20 M	20 M	20 M	20 M	20 M
DIBROMOBENZENE, 1,4-	106-37-6	370 G	1,000 G	20,000 S	20,000 S	20,000 S	370 G	1,000 G	
DIBROMOETHANE, 1,2- (ETHYLENE DIBROMIDE)	106-93-4	0.05 M	0.05 M	5 M	5 M	5 M	5 M	5 M	5 M
DIBROMOMETHANE	74-95-3	97 N	200 N	9,700 N	20,000 N	20,000 N	9,700 N	20,000 N	
DIBUTYL PHTHALATE, N-	84-74-2	3,700 G	10,000 G	370,000 G	400,000 S	400,000 S	400,000 S	400,000 S	
DICHLORO-2-BUTENE, 1,4-	764-41-0	0.016 N	0.069 N	1.6 N	6.9 N	6.9 N	0.016 N	0.069 N	
DICHLOROBENZENE, 1,2-	95-50-1	600 M	600 M	60,000 M	60,000 M	60,000 M	60,000 M	60,000 M	60,000 M

All concentrations in µg/L

H = Lifetime health advisory level

R = Residential

G = Ingestion

NR = Non-Residential

N = Inhalation

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	NR	R	NR	R	NR
DICHLOROBENZENE, 1,3-	541-73-1	600 H	600 H	60,000 H	60,000 H	60,000 H	60,000 H	6,000 H	6,000 H
DICHLOROBENZENE, P-	106-46-7	75 M	75 M	7,500 M	7,500 M	7,500 M	7,500 M	7,500 M	7,500 M
DICHLOROBENZIDINE, 3,3'-	91-94-1	1.5 G	5.8 G	150 G	580 G	1,500 G	3,100 S		
DICHLORODIFLUOROMETHANE (FREON 12)	75-71-8	1,000 H	1,000 H	100,000 H	100,000 H	100,000 H	100,000 H	100,000 H	100,000 H
DICHLOROETHANE, 1,1-	75-34-3	27 N	110 N	2700 N	11,000 N	270 N	1,100 N		
DICHLOROETHANE, 1,2-	107-06-2	5 M	5 M	500 M	500 M	50 M	50 M	50 M	50 M
DICHLOROETHYLENE, 1,1-	75-35-4	7 M	7 M	700 M	700 M	70 M	70 M	70 M	70 M
DICHLOROETHYLENE, CIS-1,2-	156-59-2	70 M	70 M	7,000 M	7,000 M	700 M	700 M	700 M	700 M
DICHLOROETHYLENE, TRANS-1,2-	156-60-5	100 M	100 M	10,000 M	10,000 M	1,000 M	1,000 M	1,000 M	1,000 M

All concentrations in µg/L

H = Lifetime health advisory level

R = Residential

G = Ingestion

N = Inhalation

NR = Non-Residential

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS			
		TDS ≤ 2500			TDS > 2500						
		R		NR	R		NR	R		NR	
		5 M	20 H	5 M	500 M	2,000 H	7,000 M	500 M	20,000 H	7,000 M	500 M
DICHLOROMETHANE (METHYLENE CHLORIDE)	75-09-2	5 M	20 H	5 M	500 M	2,000 H	7,000 M	500 M	20,000 H	7,000 M	500 M
DICHLOROPHENOL, 2,4-	120-83-2	20 H	70 M	20 H	2,000 H	7,000 M	500 M	20,000 H	7,000 M	500 M	20,000 H
DICHLOROPHENOXACETIC ACID, 2,4- (2,4-D)	94-75-7	70 M	5 M	70 M	660 G	2,600 G	20,000 M	20,000 M	20,000 M	20,000 M	20,000 M
DICHLOROPROPANE, 1,2-	78-87-5	5 M	26 G	200 M	52 N	220 N	0.52 N	0.52 N	0.52 N	0.52 N	0.52 N
DICHLOROPROPENE, 1,3-	542-75-6	6.6 G	200 M	200 M	55 N	120 N	4.1 G	16 G	41 G	160 G	160 G
DICHLOROPROPIONIC ACID, 2,2- (DALAPON)	75-99-0	200 M	0.52 N	2.2 N	55 N	120 N	4.1 G	16 G	41 G	160 G	160 G
DICHLORVOS	62-73-7	0.52 N	2.2 N	2.2 N	52 N	220 N	0.52 N	0.52 N	0.52 N	0.52 N	0.52 N
DICYCLOPENTADIENE	77-73-6	0.55 N	1.2 N	1.2 N	55 N	120 N	0.55 N	0.55 N	0.55 N	0.55 N	0.55 N
DIELDRIN	60-57-1	0.041 G	0.16 G	0.16 G	4.1 G	16 G	41 G	160 G	160 G	160 G	160 G

All concentrations in µg/L

R = Residential

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

All concentrations in µg/L
 NR = Non-Residential
 M = Maximum Contaminant Level
 R = Residential
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR	R	R	NR	NR	R	R	NR
DIETHYL PHTHALATE	84-66-2	5,000 H	5,000 H	500,000 H	500,000 H	500,000 H	1,100,000 S	1,100,000 S	1,100,000 S	200 S
DIFLUBENZURON	35367-38-5	200 S	200 S	200 S	200 S	200 S	200 S	200 S	200 S	200 S
DIMETHOATE	60-51-5	7.3 G	20 G	730 G	730 G	2,000 G	2,000 G	7,300 G	20,000 G	20,000 G
DIMETHOXYBENZIDINE, 3,3-	119-90-4	47 G	190 G	4,700 G	4,700 G	19,000 G	19,000 G	47,000 G	60,000 S	60,000 S
DIMETHYLAMINOAZOBENZENE, P-	60-11-7	0.14 G	0.57 G	14 G	14 G	57 G	57 G	140 G	570 G	570 G
DIMETHYLANILINE, N,N-	121-69-7	73 G	200 G	7,300 G	7,300 G	20,000 G	20,000 G	7,300 G	20,000 G	20,000 G
DIMETHYLBENZIDINE, 3,3-	119-93-7	0.072 G	0.28 G	7.2 G	7.2 G	28 G	28 G	72 G	280 G	280 G
DIMETHYLPHENOL, 2,4-	105-67-9	730 G	2,000 G	73,000 G	73,000 G	200,000 G	200,000 G	730,000 G	2,000,000 G	2,000,000 G
DINITROBENZENE, 1,3-	99-65-0	1 H	1 H	100 H	100 H	100 H	100 H	1,000 H	1,000 H	1,000 H

All concentrations in µg/L

H = Lifetime health advisory level

G = Ingestion

R = Residential

NR = Non-Residential

N = Inhalation

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	R	NR	R	R	NR
DINITROPHENOL, 2,4-	51-28-5	19 N	41 N	1,900 N	4,100 N		190 N	410 N	
DINITROTOLUENE, 2,4-	121-14-2	2.1 G	8.4 G	210 G	840 G		2,100 G	8,400 G	
DINITROTOLUENE, 2,6- (2,6-DNT)	606-20-2	37 G	100 G	3,700 G	10,000 G		37,000 G	100,000 G	
DINOSEB	88-85-7	7 M	7 M	700 M	700 M		700 M	700 M	
DIOXANE, 1,4-	123-91-1	5.6 N	24 N	560 N	2,400 N		56 N	240 N	
DIPHENAMID	957-51-7	200 H	200 H	20,000 H	20,000 H		200 H	200 H	
DIPHENYLAMINE	122-39-4	200 H	200 H	20,000 H	20,000 H		200,000 H	200,000 H	
DIPHENYLHYDRAZINE, 1,2-	122-66-7	0.83 G	3.3 G	83 G	250 S		250 S	250 S	
DIQUAT	85-00-7	20 M	20 M	2,000 M	2,000 M		20 M	20 M	

All concentrations in µg/L

G = Ingestion

N = Inhalation

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500		TDS > 2500					
		R	NR	R	NR	R	NR	R	NR
DISULFOTON	298-04-4	0.3 H	0.3 H	30 H	30 H	30 H	30 H	30 H	30 H
DIURON	330-54-1	10 H	10 H	1,000 H	1,000 H	1,000 H	1,000 H	10 H	10 H
ENDOSULFAN	115-29-7	58 N	120 N	480 S	480 S	480 S	480 S	480 S	480 S
ENDOSULFAN I (ALPHA)	959-98-8	220 G	500 S	500 S	500 S	500 S	220 G	220 G	500 S
ENDOSULFAN II (BETA)	33213-65-9	220 G	450 S	450 S	450 S	450 S	220 G	220 G	450 S
ENDOSULFAN SULFATE	1031-07-8	120 S	120 S	120 S	120 S	120 S	120 S	120 S	120 S
ENDOTHALL	145-73-3	100 M	100 M	10,000 M	10,000 M	10,000 M	100 M	100 M	100 M
ENDRIN	72-20-8	2 M	2 M	200 M	200 M	200 M	2 M	2 M	2 M
EPICHLOROHYDRIN	106-89-8	2.8 N	5.8 N	280 N	280 N	580 N	280 N	280 N	580 N

All concentrations in µg/L H = Lifetime health advisory level

R = Residential G = Ingestion

NR = Non-Residential N = Inhalation

M = Maximum Contaminant Level S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R		NR	R		NR	R	
ETHEPHON	16672-87-0	180 G	510 G	18,000 G	51,000 G		180 G	510 G	
ETHION	563-12-2	18 G	51 G	850 S	850 S		18 G	51 G	
ETHOXYETHANOL, 2- (EGEE)	110-80-5	550 N	1,200 N	55,000 N	120,000 N		55,000 N	120,000 N	
ETHYL ACETATE	141-78-6	8,700 N	18,000 N	870,000 N	1,800,000 N		870,000 N	1,800,000 N	
ETHYL ACRYLATE	140-88-5	3.1 N	13 N	310 N	1,300 N		310 N	1,300 N	
ETHYL BENZENE	100-41-4	700 M	700 M	70,000 M	70,000 M		70,000 M	70,000 M	
ETHYL DIPROPYLTHIOCARBAMATE, S- (EPTC)	759-94-4	910 G	2,600 G	91,000 G	260,000 G		910 G	2,600 G	
ETHYL ETHER	60-29-7	1,900 N	4,100 N	190,000 N	410,000 N		1,900 N	4,100 N	
ETHYL METHACRYLATE	97-63-2	870 N	1,800 N	87,000 N	180,000 N		870 N	1,800 N	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R		NR	R		NR	R	
ETHYLENE GLYCOL	107-21-1	14,000 H	14,000 H	1,400,000 H	1,400,000 H	14,000,000 H	1,400,000 H	1,400,000 H	1,400,000 H
ETHYLENE THIOUREA (ETU)	96-45-7	3 H	3 H	300 H	300 H	300 H	3,000 H	3,000 H	3,000 H
ETHYLP-NITROPHENYL PHENYLPHOSPHOROTHIOATE	2104-64-5	0.37 G	1 G	37 G	100 G	100 G	0.37 G	0.37 G	1 G
FENAMIPHOS	22224-92-6	2 H	2 H	200 H	200 H	200 H	2 H	2 H	2 H
FENVALERATE (PYDRIN)	51630-58-1	85 S	85 S	85 S	85 S	85 S	85 S	85 S	85 S
FLUOMETURON	2164-17-2	90 H	90 H	9,000 H	9,000 H	9,000 H	90 H	90 H	90 H
FLUORANTHENE	206-44-0	260 S	260 S	260 S	260 S	260 S	260 S	260 S	260 S
FLUORENE	86-73-7	1,500 G	1,900 S	1,900 S	1,900 S	1,900 S	1,900 S	1,900 S	1,900 S

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

250-87

(285821) No. 327 Feb. 02

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
FLUOROTRICHLOROMETHANE (FREON 11)	75-69-4	2,000 H	2,000 H		200,000 H	200,000 H		200,000 H	200,000 H	
FONOFOS	944-22-9	10 H	10 H		1,000 H	1,000 H		10 H	10 H	
FORMALDEHYDE	50-00-0	1,000 H	1,000 H		100,000 H	100,000 H		100,000 H	100,000 H	
FORMIC ACID	64-18-6	19,000 N	41,000 N		1,900,000 N	4,100,000 N		190,000 N	410,000 N	
FOSETYL-AL	39148-24-8	110,000 G	310,000 G		11,000,000 G	31,000,000 G		110,000 G	310,000 G	
FURAN	110-00-9	9.7 N	20 N		970 N	2,000 N		970 N	2,000 N	
FURFURAL	98-01-1	110 G	290 N		11,000 G	29,000 N		110 G	290 N	
GLYPHOSATE	1071-83-6	700 M	700 M		70,000 M	70,000 M		700 M	700 M	
HEPTACHLOR	76-44-8	0.4 M	0.4 M		40 M	40 M		180 S	180 S	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS			
		TDS ≤ 2500			TDS > 2500			R		NR	
		R	NR	M	R	NR	M	R	NR	R	NR
HEPTACHLOR EPOXIDE	1024-57-3	0.2 M	0.2 M	0.2 M	20 M	20 M	20 M	200 M	200 M	200 M	200 M
HEXACHLOROBENZENE	118-74-1	1 M	1 M	1 M	6 S	6 S	6 S	6 S	6 S	6 S	6 S
HEXACHLOROBUTADIENE	87-68-3	1 H	1 H	1 H	100 H	100 H	100 H	1,000 H	1,000 H	1,000 H	1,000 H
HEXACHLOROCYCLOPENTADIENE	77-47-4	50 M	50 M	50 M	1,800 S	1,800 S	1,800 S	1,800 S	1,800 S	1,800 S	1,800 S
HEXACHLOROETHANE	67-72-1	1 H	1 H	1 H	100 H	100 H	100 H	100 H	100 H	100 H	100 H
HEXANE	110-54-3	550 N	1,200 N	1,200 N	9,500 S	9,500 S	9,500 S	550 N	550 N	1,200 N	1,200 N
HEXYTHIAZOX (SAVEY)	78587-05-0	500 S	500 S	500 S	500 S	500 S	500 S	500 S	500 S	500 S	500 S
HYDRAZINE/HYDRAZINE SULFATE	302-01-2	0.0088 N	0.038 N	0.038 N	0.88 N	3.8 N	3.8 N	0.088 N	0.088 N	0.38 N	0.38 N
HYDROQUINONE	123-31-9	1,500 G	4,100 G	4,100 G	150,000 G	410,000 G	410,000 G	1,500,000 G	1,500,000 G	4,100,000 G	4,100,000 G

All concentrations in µg/L

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

M = Maximum Contaminant Level

NR = Non-Residential

R = Residential

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
INDENO(1,2,3-CD)PYRENE	193-39-5	0.9 G	3.6 G		62 S	62 S		62 S	62 S	
IPRODIONE	36734-19-7	1,500 G	4,100 G		13,000 S	13,000 S		1,500 G	4,100 G	
ISOBUTYL ALCOHOL	78-83-1	2,900 N	6,100 N		290,000 N	610,000 N		290,000 N	610,000 N	
ISOPHORONE	78-59-1	100 H	100 H		10,000 H	10,000 H		100,000 H	100,000 H	
KEPONE	143-50-0	0.041 G	0.16 G		4.1 G	16 G		41 G	160 G	
MALATHION	121-75-5	100 H	100 H		10,000 H	10,000 H		10,000 H	10,000 H	
MALEIC HYDRAZIDE	123-33-1	4,000 H	4,000 H		400,000 H	400,000 H		4,000 H	4,000 H	
MANEB	12427-38-2	180 G	510 G		18,000 G	23,000 S		180 G	510 G	
MERPHOS OXIDE	78-48-8	1.1 G	3.1 G		110 G	310 G		1.1 G	3.1 G	

All concentrations in µg/L
 M = Maximum Contaminant Level
 R = Residential
 NR = Non-Residential
 H = Lifetime health advisory level
 N = Inhalation
 S = Aqueous solubility cap
 G = Ingestion

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
METHACRYLONITRILE	126-98-7	1.9 N	4.1 N		190 N	410 N		1.9 N		4.1 N
METHAMIDOPHOS	10265-92-6	1.8 G	5.1 G		180 G	510 G		1.8 G		5.1 G
METHANOL	67-56-1	4,900 N	10,000 N		490,000 N	1,000,000 N		490,000 N		1,000,000 N
METHOMYL	16752-77-5	200 H	200 H		20000 H	20000 H		200 H		200 H
METHOXYCHLOR	72-43-5	40 M	40 M		45 S	45 S		45 S		45 S
METHOXYETHANOL, 2-	109-86-4	37 G	100 G		3,700 G	10,000 G		37 G		100 G
METHYL ACETATE	79-20-9	37,000 G	100,000 G		3,700,000 G	10,000,000 G		37,000 G		100,000 G
METHYL ACRYLATE	96-33-3	1,100 G	3,100 G		110,000 G	310,000 G		110,000 G		310,000 G
METHYL CHLORIDE	74-87-3	3 H	3 H		300 H	300 H		300 H		300 H

All concentrations in µg/L

R = Residential

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
METHYL ETHYL KETONE	78-93-3	2,800 N	5,800 N		280,000 N	580,000 N		280,000 N	580,000 N	
METHYL ISOBUTYL KETONE	108-10-1	190 N	410 N		19,000 N	41,000 N		19,000 N	41,000 N	
METHYL METHACRYLATE	80-62-6	1,900 N	4,100 N		190,000 N	410,000 N		190,000 N	410,000 N	
METHYL METHANESULFONATE	66-27-3	6.7 G	26 G		670 G	2600 G		6.7 G	26 G	
METHYL PARATHION	298-00-0	2 H	2 H		200 H	200 H		200 H	200 H	
METHYL STYRENE (MIXED ISOMERS)	25013-15-4	220 G	610 G		22,000 G	61,000 G		220 G	610 G	
METHYL TERT-BUTYL ETHER (MTBE)	1634-04-4	20 H	20 H		2,000 H	2,000 H		200 H	200 H	
METHYLENE BIS(2-CHLOROANILINE), 4,4'-	101-14-4	5.1 G	20 G		510 G	2,000 G		5.1 G	20 G	
METHYLNAPHTHALENE, 2-	91-57-6	730 G	2,000 G		25,000 S	25,000 S		730 G	2,000 G	

All concentrations in µg/L
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 N = Inhalation
 R = Residential
 G = Ingestion
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS			
		TDS ≤ 2500			TDS > 2500			R		NR	
		R	NR		R	NR		R	NR	R	NR
METHYLSTYRENE, ALPHA	98-83-9	680 N	1,400 N		68,000 N	140,000 N		680 N		680 N	1,400 N
NAPHTHALENE	91-20-3	100 H	100 H		10,000 H	10,000 H		30,000 S		30,000 S	
NAPHTHYLAMINE, 1-	134-32-7	0.37 G	1.4 G		37 G	140 G		370 G		1,400 G	
NAPHTHYLAMINE, 2-	91-59-8	0.37 G	1.4 G		37 G	140 G		370 G		1,400 G	
NAPROPAMIDE	15299-99-7	3,700 G	10,000 G		70,000 S	70,000 S		3,700 G		10,000 G	
NITROANILINE, M-	99-09-2	2.1 G	5.8 G		210 G	580 G		2.1 G		5.8 G	
NITROANILINE, O-	88-74-4	2.1 G	5.8 G		210 G	580 G		2.1 G		5.8 G	
NITROANILINE, P-	100-01-6	2.1 G	5.8 G		210 G	580 G		2.1 G		5.8 G	
NITROBENZENE	98-95-3	18 G	51 G		1,800 G	5,100 G		18,000 G		51,000 G	

All concentrations in µg/L

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

NR = Non-Residential

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR	G	R	NR	G	R	G	NR
NITROPHENOL, 2-	88-75-5	290	G	820	G	29,000	G	290,000	G	820,000
NITROPHENOL, 4-	100-02-7	60	H	60	H	6,000	H	60,000	H	60,000
NITROPROPANE, 2-	79-46-9	0.016	N	0.068	N	1.6	N	0.16	N	0.68
NITROSODIETHYLAMINE, N-	55-18-5	0.001	N	0.0043	N	0.1	N	0.01	N	0.043
NITROSODIMETHYLAMINE, N-	62-75-9	0.0031	N	0.013	N	0.31	N	0.031	N	0.13
NITROSO-DI-N-BUTYLAMINE, N-	924-16-3	0.027	N	0.11	N	2.7	N	2.7	N	11
NITROSODI-N-PROPYLAMINE, N-	621-64-7	0.094	G	0.37	G	9.4	G	94	G	370
NITROSODIPHENYLAMINE, N-	86-30-6	130	G	530	G	13,000	G	35,000	S	35,000
NITROSO-N-ETHYLUREA, N-	759-73-9	0.0047	G	0.019	G	0.47	G	0.47	G	1.9

All concentrations in µg/L
 G = Ingestion
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 S = Aqueous solubility cap

250-94

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR	G	R	NR	S	R	S	NR
OCTYL PHTHALATE, DI-N-	117-84-0	730 G	2,000 G	3,000 S	3,000 S	3,000 S	3,000 S	3,000 S	3,000 S	NR
OXAMYL (VYDATE)	23135-22-0	200 M	200 M	20,000 M	20,000 M	20,000 M	20,000 M	200 M	200 M	M
PARATHION	56-38-2	220 G	610 G	20,000 S	20,000 S	20,000 S	20,000 S	220 G	610 G	G
PCB-1016 (AROCOLOR)	12674-11-2	2.6 G	7.2 G	250 S	250 S	250 S	250 S	2.6 G	7.2 G	G
PCB-1221 (AROCOLOR)	11104-28-2	1.3 G	5.2 G	130 G	130 G	520 G	520 G	1.3 G	5.2 G	G
PCB-1232 (AROCOLOR)	11141-16-5	1.3 G	5.2 G	130 G	130 G	520 G	520 G	1.3 G	5.2 G	G
PCB-1242 (AROCOLOR)	53469-21-9	1.3 G	5.2 G	100 S	100 S	100 S	100 S	1.3 G	5.2 G	G
PCB-1248 (AROCOLOR)	12672-29-6	0.37 G	1.4 G	37 G	37 G	37 G	37 G	0.37 G	1.4 G	G

All concentrations in µg/L
R = Residential

NR = Non-Residential
M = Maximum Contaminant Level

H = Lifetime health advisory level
G = Ingestion

N = Inhalation

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
PCB-1254 (AROCOLOR)	11097-69-1	0.37 G	1.4 G		37 G			0.37 G		1.4 G
PCB-1260 (AROCOLOR)	11096-82-5	1.1 G	4.3 G		80 S			1.1 G		4.3 G
PEBULATE	1114-71-2	1,800 G	5,100 G		92,000 S			1,800 G		5,100 G
PENTACHLOROBENZENE	608-93-5	29 G	82 G		740 S			740 S		740 S
PENTACHLORONITROBENZENE	82-68-8	2.5 G	10 G		250 G			440 S		440 S
PENTACHLOROPHENOL	87-86-5	1 M	1 M		100 M			1,000 M		1,000 M
PHENACETIN	62-44-2	300 G	1,200 G		30,000 G			300,000 G		760,000 S
PHENANTHRENE	85-01-8	1,100 S	1,100 S		1,100 S			1,100 S		1,100 S
PHENOL	108-95-2	4,000 H	4,000 H		400,000 H			400,000 H		400,000 H

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
PHENYLENEDIAMINE, M-	108-45-2	220 G	610 G		22,000 G	61,000 G		220,000 G	610,000 G	
PHENYLPHENOL, 2-	90-43-7	340 G	1,300 G		34,000 G	130,000 G		340,000 G	700,000 G	
PHORATE	298-02-2	1.9 N	4.1 N		190 N	410 N		1.9 N	4.1 N	
PHTHALIC ANHYDRIDE	85-44-9	73,000 G	200,000 G		6,200,000 S	6,200,000 S		6,200,000 S	6,200,000 S	
PICLORAM	1918-02-1	500 M	500 M		50,000 M	50,000 M		500 M	500 M	
POLYCHLORINATED BIPHENYLS (AROCLOS) (PCBS)	1336-36-3	0.5 M	0.5 M		50 M	50 M		0.5 M	0.5 M	
PRONAMIDE	23950-58-5	50 H	50 H		5,000 H	5,000 H		50 H	50 H	
PROPANIL	709-98-8	180 G	510 G		18,000 G	51,000 G		180 G	510 G	
PROPHAM	122-42-9	730 G	2,000 G		73,000 G	200,000 G		730 G	2,000 G	

All concentrations in µg/L
 M = Maximum Contaminant Level
 R = Residential
 NR = Non-Residential
 N = Inhalation
 H = Lifetime health advisory level
 S = Aqueous solubility cap
 G = Ingestion

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	R	NR	R	NR	R
PROPYLBENZENE, N-	103-65-1	1,500 G	4,100 G	52,000 S	52,000 S	52,000 S	1,500 G	4,100 G	
PROPYLENE OXIDE	75-56-9	2.8 G	11 G	280 G	1,100 G	1,100 G	2.8 G	11 G	
PYRENE	129-00-0	130 S	130 S	130 S	130 S	130 S	130 S	130 S	
PYRIDINE	110-86-1	9.7 N	20 N	970 N	2,000 N	2,000 N	97 N	200 N	
QUINOLINE	91-22-5	0.055 G	0.22 G	5.5 G	22 G	22 G	55 G	220 G	
QUIZALOFOP (ASSURE)	76578-14-8	300 S	300 S	300 S	300 S	300 S	300 S	300 S	
RONNEL	299-84-3	1,800 G	5,100 G	40,000 S	40,000 S	40,000 S	1,800 G	5,100 G	
SIMAZINE	122-34-9	4 M	4 M	400 M	400 M	400 M	4 M	4 M	
STRYCHNINE	57-24-9	11 G	31 G	1,100 G	3,100 G	3,100 G	11,000 G	31,000 G	

All concentrations in µg/L

H = Lifetime health advisory level

R = Residential

G = Ingestion

NR = Non-Residential

N = Inhalation

M = Maximum Contaminant Level

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
STYRENE	100-42-5	100 M	100 M		10,000 M	10,000 M		10,000 M	10,000 M	M
TEBUTHIURON	34014-18-1	500 H	500 H		50,000 H	50,000 H		500 H	500 H	H
TERBACIL	5902-51-2	90 H	90 H		9,000 H	9,000 H		90 H	90 H	H
TERBUFOS	13071-79-9	0.9 H	0.9 H		90 H	90 H		0.9 H	0.9 H	H
TETRACHLOROBENZENE, 1,2,4,5-	95-94-3	11 G	31 G		580 S	580 S		580 S	580 S	S
TETRACHLORODIBENZO-P-DIOXIN, 2,3,7,8- (TCDD)	1746-01-6	0.00003 M	0.00003 M		0.003 M	0.003 M		0.019 S	0.019 S	S
TETRACHLOROETHANE, 1,1,1,2-	630-20-6	70 H	70 H		7,000 H	7,000 H		7,000 H	7,000 H	H
TETRACHLOROETHANE, 1,2,2,2-	79-34-5	0.3 N	0.3 N		30 N	30 N		30 N	30 N	N
TETRACHLOROETHYLENE (PCE)	127-18-4	5 M	5 M		500 M	500 M		50 M	50 M	M

All concentrations in µg/L

R = Residential

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
TETRACHLOROPHENOL, 2,3,4,6-	58-90-2	290 N	610 N		29,000 N	61,000 N		29,000 N		61,000 N
TETRAETHYL LEAD	78-00-2	0.0037 G	0.01 G		0.37 G	1 G		3.7 G		10 G
TETRAETHYLDITHIOPYRO- PHOSPHATE	3689-24-5	4.9 N	10 N		490 N	1,000 N		4.9 N		10 N
THIOFANOX	39196- 18-4	11 G	31 G		1,100 G	3,100 G		11 G		31 G
THIRAM	137-26-8	180 G	510 G		18,000 G	30,000 S		180 G		510 G
TOLUENE	108-88-3	1,000 M	1,000 M		100,000 M	100,000 M		100,000 M		100,000 M
TOLUIDINE, M-	108-44-1	2.8 G	11 G		280 G	1,100 G		2.8 G		11 G
TOLUIDINE, O	95-53-4	2.8 G	11 G		280 G	1,100 G		2,800 G		11,000 G
TOLUIDINE, P-	106-49-0	3.5 G	14 G		350 G	1,400 G		3.5 G		14 G

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS	
		TDS ≤ 2500			TDS > 2500				
		R	NR	R	R	NR	R	R	NR
TOXAPHENE	8001-35-2	3 M	3 M	300 M	300 M	300 M	3 M	3 M	3 M
TRIALLATE	2303-17-5	470 G	1,300 G	4,000 S	4,000 S	4,000 S	470 G	470 G	1,300 G
TRIBROMOMETHANE (BROMOFORM)	75-25-2	100 M	100 M	10,000 M	10,000 M	10,000 M	1,000 M	1,000 M	1,000 M
TRICHLORO-1,2,2- TRIFLUOROETHANE, 1,1,2-	76-13-1	83,000 N	170,000 S	170,000 S	170,000 S	170,000 S	170,000 N	170,000 S	
TRICHLOROBENZENE, 1,2,4-	120-82-1	70 M	70 M	7,000 M	7,000 M	7,000 M	44,000 S	44,000 S	
TRICHLOROBENZENE, 1,3,5-	108-70-3	40 H	40 H	4,000 H	4,000 H	4000 H	40 H	40 H	40 H
TRICHLOROETHANE, 1,1,1-	71-55-6	200 M	200 M	20,000 M	20,000 M	20,000 M	2,000 M	2,000 M	2,000 M
TRICHLOROETHANE, 1,1,2-	79-00-5	5 M	5 M	500 M	500 M	500 M	50 M	50 M	50 M
TRICHLOROETHYLENE (TCE)	79-01-6	5 M	5 M	500 M	500 M	500 M	50 M	50 M	50 M

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
TRICHLOROPHENOL, 2,4,5-	95-95-4	3,700 G	10,000 G		370,000 G	1,000,000 G		100,000 S	1,000,000 S	
TRICHLOROPHENOL, 2,4,6-	88-06-2	11 G	31 G		1,100 G	3,100 G		11,000 G	31,000 G	
TRICHLOROPHENOXACETIC ACID, 2,4,5- (2,4,5-T)	93-76-5	70 H	70 H		7,000 H	7,000 H		70,000 H	70,000 H	
TRICHLOROPHENOXYPROPIONIC ACID, 2,4,5- (2,4,5-TP)	93-72-1	50 M	50 M		5,000 M	5,000 M		50 M	50 M	
TRICHLOROPROPANE, 1,1,2-	598-77-6	180 G	510 G		18,000 G	51,000 G		180 G	510 G	
TRICHLOROPROPANE, 1,2,3-	96-18-4	40 H	40 H		4,000 H	4,000 H		4,000 H	4,000 H	
TRICHLOROPROPENE, 1,2,3-	96-19-5	180 G	510 G		18,000 G	51,000 G		180 G	510 G	
TRIFLURALIN	1582-09-8	5 H	5 H		500 H	500 H		5 H	5 H	
TRIMETHYLBENZENE, 1,3,4- (TRIMETHYLBENZENE, 1,2,4-)	95-63-6	16 N	35 N		1,600 N	3,500 N		1,600 N	3,500 N	

All concentrations in µg/L
 R = Residential
 NR = Non-Residential
 M = Maximum Contaminant Level
 H = Lifetime health advisory level
 G = Ingestion
 N = Inhalation
 S = Aqueous solubility cap

TABLE 1—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS				NON-USE AQUIFERS			
		TDS ≤ 2500		TDS > 2500		R		NR	
		R	NR	R	NR	R	NR	R	NR
TRIMETHYLBENZENE, 1,3,5-	108-67-8	16 N	35 N	1,600 N	3,500 N	16 N	35 N	16 N	35 N
TRINITROTOLUENE, 2,4,6-	118-96-7	2 H	2 H	200 H	200 H	2 H	2 H	2 H	2 H
VINYL ACETATE	108-05-4	550 N	1200 N	55,000 N	120,000 N	550 N	1,200 N	550 N	1,200 N
VINYL BROMIDE (BROMOETHENE)	593-60-2	1.4 N	5.8 N	140 N	580 N	14 N	58 N	14 N	58 N
VINYL CHLORIDE	75-01-4	2 M	2 M	200 M	200 M	20 M	20 M	20 M	20 M
WARFARIN	81-81-2	11 G	31 G	1,100 G	3,100 G	11,000 G	17,000 S	11,000 G	17,000 S
XYLENES (TOTAL)	1330-20-7	10,000 M	10,000 M	180,000 S	180,000 S	180,000 S	180,000 S	180,000 S	180,000 S
ZINEB	12122-67-7	1,800 G	5,100 G	10,000 S	10,000 S	1,800 G	5,100 G	1,800 G	5,100 G

All concentrations in µg/L S = Aqueous solubility cap

R = Residential

NR = Non-Residential

M = Maximum Contaminant Level

H = Lifetime health advisory level

G = Ingestion

N = Inhalation

APPENDIX A
TABLE 2—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR INORGANIC REGULATED SUBSTANCES IN GROUNDWATER

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS			
		TDS ≤ 2500			TDS > 2500			R		NR	
		R	NR		R	NR		R	NR	R	NR
ANTIMONY	7440-36-0	6 M	6 M		600 M	600 M		6,000 M	6,000 M	6,000 M	M
ARSENIC	7440-38-2	50 M	50 M		5,000 M	5,000 M		50,000 M	50,000 M	50,000 M	M
ASBESTOS (fibers/L)	12001-29-5	7,000,000 M	7,000,000 M		7,000,000 M	7,000,000 M		7,000,000 M	7,000,000 M	7,000,000 M	M
BARIUM AND COMPOUNDS	7440-39-3	2,000 M	2,000 M		200,000 M	200,000 M		2,000,000 M	2,000,000 M	2,000,000 M	M
BERYLLIUM	7440-41-7	4 M	4 M		400 M	400 M		4,000 M	4,000 M	4,000 M	M
BORON AND COMPOUNDS	7440-42-8	600 H	600 H		60,000 H	60,000 H		600,000 H	600,000 H	600,000 H	H
CADMIUM	7440-43-9	5 M	5 M		500 M	500 M		5,000 M	5,000 M	5,000 M	M
CHROMIUM, TOTAL	16065-83-1	100 M	100 M		10,000 M	10,000 M		100,000 M	100,000 M	100,000 M	M

All concentrations in µg/L (except asbestos) SMCL = Secondary Maximum Contaminant Level

M = Maximum Contaminant Level G = Ingestion

H = Lifetime Health Advisory Level N = Inhalation

TABLE 2—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR INORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R		NR
COBALT	7440-48-4	730	G	2,000	G	73,000	G	73,000	G	200,000
COPPER	7440-50-8	1,000	M	1,000	M	100,000	M	1,000,000	M	1,000,000
CYANIDE, FREE	57-12-5	200	M	200	M	20,000	M	200,000	M	200,000
LEAD	7439-92-1	5	M	5	M	500	M	5,000	M	5,000
MERCURY	7439-97-6	2	M	2	M	200	M	2,000	M	2,000
NICKEL	7440-02-0	100	H	100	H	10,000	H	100,000	H	100,000
NITRATE NITROGEN	14797-55-8	10,000	M	10,000	M	1,000,000	M	10,000,000	M	10,000,000
NITRITE NITROGEN	14797-65-0	1,000	M	1,000	M	100,000	M	1,000,000	M	1,000,000
SELENIUM	7782-49-2	50	M	50	M	5,000	M	50,000	M	50,000

All concentrations in µg/L (except asbestos)
 M = Maximum Contaminant Level
 H = Lifetime Health Advisory Level
 SMCL = Secondary Maximum Contaminant Level
 G = Ingestion
 N = Inhalation

TABLE 2—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR INORGANIC REGULATED SUBSTANCES IN GROUNDWATER—(Continued)

REGULATED SUBSTANCE	CASRN	USED AQUIFERS						NON-USE AQUIFERS		
		TDS ≤ 2500			TDS > 2500					
		R	NR		R	NR		R	NR	
SILVER	7440-22-4	100 H	100 H		10,000 H	10,000 H		100,000 H	100,000 H	
SULFATE		500,000 M	500,000 M		50,000,000 M	50,000,000 M		500,000,000 M	500,000,000 M	
THALLIUM	7440-28-0	2 M	2 M		200 M	200 M		2,000 M	2,000 M	
TIN	7440-31-5	22,000 G	61,000 G		2,200,000 G	6,100,000 G		22,000,000 G	61,000,000 G	
VANADIUM	7440-62-2	260 G	720 G		26,000 G	72,000 G		260,000 G	720,000 G	
ZINC AND COMPOUNDS	7440-66-6	2,000 H	2,000 H		200,000 H	200,000 H		2,000,000 H	2,000,000 H	

Secondary Contaminants

REGULATED SUBSTANCE	SMCL
ALUMINUM	200
CHLORIDE	250,000
FLUORIDE	2,000
IRON	300
MANGANESE	50

All concentrations in µg/L (except asbestos)

M = Maximum Contaminant Level

H = Lifetime Health Advisory Level

SMCL = Secondary Maximum Contaminant Level

G = Ingestion

N = Inhalation

APPENDIX A

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
ACENAPHTHENE	83-32-9	13,000	G	170,000	G	190,000	C
ACENAPHTHYLENE	208-96-8	13,000	G	170,000	G	190,000	C
ACEPHATE	30560-19-1	880	G	9,100	G	190,000	C
ACETALDEHYDE	75-07-0	140	N	480	N	560	N
ACETONE	67-64-1	10,000	C	10,000	C	10,000	C
ACETONITRILE	75-05-8	1,100	N	3,200	N	3,600	N
ACETOPHENONE	98-86-2	10,000	C	10,000	C	10,000	C
ACETYLAMINOFLUORENE, 2- (2AAF)	53-96-3	4.7	G	21	G	190,000	C
ACROLEIN	107-02-8	0.38	N	1.1	N	1.2	N
ACRYLAMIDE	79-06-1	4	G	18	G	190,000	C
ACRYLIC ACID	79-10-7	19	N	53	N	60	N
ACRYLONITRILE	107-13-1	4.7	N	24	N	28	N
ALACHLOR	15972-60-8	220	G	990	G	190,000	C
ALDICARB	116-06-3	220	G	2,800	G	190,000	C
ALDRIN	309-00-2	1.1	G	4.7	G	190,000	C
ALLYL ALCOHOL	107-18-6	330	N	930	N	1,100	N
AMINOBIIPHENYL, 4-	92-67-1	0.85	G	3.8	G	190,000	C
AMITROLE	61-82-5	19	G	84	G	190,000	C
AMMONIA	7664-41-7	1,900	N	5,300	N	6,100	N

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

250-107

(285841) No. 327 Feb. 02

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL (Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
AMMONIUM SULFAMATE	7773-06-0	44,000	G	190,000	C	190,000	C
ANILINE	62-53-3	19	N	53	N	60	N
ANTHRACENE	120-12-7	66,000	G	190,000	C	190,000	C
ATRAZINE	1912-24-9	81	G	360	G	190,000	C
BAYGON (PROPOXUR)	114-26-1	880	G	11,000	G	190,000	C
BENOMYL	17804-35-2	11,000	G	140,000	G	190,000	C
BENTAZON	25057-89-0	6,600	G	84,000	G	190,000	C
BENZENE	71-43-2	41	N	210	N	240	N
BENZIDINE	92-87-5	0.078	G	0.34	G	190,000	C
BENZO[A]ANTHRACENE	56-55-3	25	G	110	G	190,000	C
BENZO[A]PYRENE	50-32-8	2.5	G	11	G	190,000	C
BENZO[B]FLUORANTHENE	205-99-2	25	G	110	G	190,000	C
BENZO[GHI]PERYLENE	191-24-2	13,000	G	170,000	G	190,000	C
BENZO[K]FLUORANTHENE	207-08-9	250	G	1100	G	190,000	C
BENZOIC ACID	65-85-0	190,000	C	190,000	C	190,000	C
BENZOTRICHLORIDE	98-07-7	1.4	G	6.1	G	10,000	C
BENZYL ALCOHOL	100-51-6	10,000	C	10,000	C	10,000	C
BENZYL CHLORIDE	100-44-7	6.4	N	33	N	38	N
BHC, ALPHA	319-84-6	2.8	G	13	G	190,000	C
BHC, BETA-	319-85-7	9.9	G	44	G	190,000	C
BHC, DELTA-	319-86-8	130	G	1,700	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
BHC, GAMMA (LINDANE)	58-89-9	14	G	61	G	190,000	C
BIPHENYL, 1,1-	92-52-4	11,000	G	140,000	G	190,000	C
BIS(2-CHLOROETHYL)ETHER	111-44-4	0.96	N	5	N	5.7	N
BIS(2-CHLORO-ISOPROPYL)ETHER	108-60-1	32	N	160	N	190	N
BIS(CHLOROMETHYL)ETHER	542-88-1	0.0051	N	0.027	N	0.031	N
BIS[2-ETHYLHEXYL] PHTHALATE	117-81-7	1,300	G	5,700	G	10,000	C
BISPHENOL A	80-05-7	11,000	G	140,000	G	190,000	C
BROMACIL	314-40-9	22,000	G	190,000	C	190,000	C
BROMOCHLOROMETHANE	74-97-5	2,200	G	10,000	C	10,000	C
BROMODICHLOROMETHANE	75-27-4	8.6	N	45	N	51	N
BROMOMETHANE	74-83-9	95	N	270	N	300	N
BROMOXYNIL	1689-84-5	4,400	G	56,000	G	190,000	C
BROMOXYNIL OCTANOATE	1689-99-2	4,400	G	56,000	G	190,000	C
BUTADIENE, 1,3-	106-99-0	5.3	G	23	G	190,000	C
BUTYL ALCOHOL, N-	71-36-3	6,600	N	10,000	C	10,000	C
BUTYLATE	2008-41-5	10,000	C	10,000	C	10,000	C
BUTYLBENZENE, N-	104-51-8	8,800	G	10,000	C	10,000	C
BUTYLBENZENE, SEC-	135-98-8	8,800	G	10,000	C	10,000	C
BUTYLBENZENE, TERT-	98-06-6	8,800	G	10,000	C	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
BUTYLBENZYL PHTHALATE	85-68-7	10,000	C	10,000	C	10,000	C
CAPTAN	133-06-2	5,100	G	23,000	G	190,000	C
CARBARYL	63-25-2	22,000	G	190,000	C	190,000	C
CARBAZOLE	86-74-8	900	G	4,000	G	190,000	C
CARBOFURAN	1563-66-2	1,100	G	14,000	G	190,000	C
CARBON DISULFIDE	75-15-0	10,000	C	10,000	C	10,000	C
CARBON TETRACHLORIDE	56-23-5	21	N	110	N	120	N
CARBOXIN	5234-68-4	22,000	G	190,000	C	190,000	C
CHLORAMBEN	133-90-4	3,300	G	42,000	G	190,000	C
CHLORDANE	57-74-9	51	G	230	G	190,000	C
CHLORO-1,1-DIFLUOROETHANE, 1-	75-68-3	190,000	C	190,000	C	190,000	C
CHLORO-1-PROPENE, 3-(ALLYL CHLORIDE)	107-05-1	19	N	53	N	61	N
CHLOROACETOPHENONE, 2-	532-27-4	1.9	G	24	G	190,000	C
CHLOROANILINE, P-	106-47-8	880	G	11,000	G	190,000	C
CHLOROBENZENE	108-90-7	4,400	G	10,000	C	10,000	C
CHLOROBENZILATE	510-15-6	66	G	290	G	10,000	C
CHLOROBUTANE, 1-	109-69-3	10,000	C	10,000	C	10,000	C
CHLORODIBROMOMETHANE	124-48-1	12	N	61	N	70	N
CHLORODIFLUOROMETHANE	75-45-6	190,000	C	190,000	C	190,000	C
CHLOROETHANE	75-00-3	6,200	G	10,000	C	10,000	C
CHLOROFORM	67-66-3	6	N	17	N	19	N

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
CHLORONAPHTHALENE, 2-	91-58-7	18,000	G	190,000	C	190,000	C
CHLORONITROBENZENE, P-	100-00-5	990	G	4,400	G	190,000	C
CHLOROPHENOL, 2-	95-57-8	330	N	920	N	1,100	N
CHLOROPRENE	126-99-8	130	N	370	N	430	N
CHLOROPROPANE, 2-	75-29-6	1,900	N	5,400	N	6,100	N
CHLOROTHALONIL	1897-45-6	1,600	G	7,200	G	190,000	C
CHLOROTOLUENE, O-	95-49-8	4,400	G	10,000	C	10,000	C
CHLORPYRIFOS	2921-88-2	660	G	8,400	G	190,000	C
CHLORSULFURON	64902-72-3	11,000	G	140,000	G	190,000	C
CHLORTHAL-DIMETHYL (DACTHAL) (DCPA)	1861-32-1	2,200	G	28,000	G	190,000	C
CHRYSENE	218-01-9	2,500	G	11,000	G	190,000	C
CRESOL	1319-77-3	1,100	G	10,000	G	10,000	G
CRESOL, O- (METHYLPHENOL, 2-)	95-48-7	10,000	C	10,000	C	10,000	C
CRESOL, M (METHYLPHENOL, 3-)	108-39-4	10,000	C	10,000	C	10,000	C
CRESOL, P (METHYLPHENOL, 4-)	106-44-5	1,100	G	14,000	G	190,000	C
CRESOL, P-CHLORO-M-	59-50-7	1,100	G	14,000	G	190,000	C
CROTONALDEHYDE	4170-30-3	9.4	G	42	G	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
CROTONALDEHYDE, TRANS-	123-73-9	9.4	G	42	G	10,000	C
CUMENE	98-82-8	7,300	N	10,000	C	10,000	C
CYCLOHEXANONE	108-94-1	10,000	C	10,000	C	10,000	C
CYFLUTHRIN	68359- 37-5	5,500	G	10,000	C	10,000	C
CYROMAZINE	66215- 27-8	1,700	G	21,000	G	190,000	C
DDD, 4,4'-	72-54-8	75	G	330	G	190,000	C
DDE, 4,4'-	72-55-9	53	G	230	G	190,000	C
DDT, 4,4'-	50-29-3	53	G	230	G	190,000	C
DI(2-ETHYLHEXYL)ADIPATE	103-23-1	10,000	C	10,000	C	10,000	C
DIALATE	2303- 16-4	18	N	93	N	110	N
DIAMINOTOLUENE, 2,4-	95-80-7	5.6	G	25	G	190,000	C
DIAZINON	333-41-5	200	G	2,500	G	190,000	C
DIBENZO[A,H]ANTHRACENE	53-70-3	2.5	G	11	G	190,000	C
DIBROMO-3- CHLOROPROPANE, 1,2-	96-12-8	3.8	N	11	N	12	N
DIBROMOBENZENE, 1,4-	106-37-6	2,200	G	28,000	G	190,000	C
DIBROMOETHANE, 1,2- (ETHYLENE DIBROMIDE)	106-93-4	0.21	G	0.93	G	8.6	N
DIBROMOMETHANE	74-95-3	670	N	1,900	N	2,100	N
DIBUTYL PHTHALATE, N-	84-74-2	10,000	C	10,000	C	10,000	C
DICHLORO-2-BUTENE, 1,4-	764-41-0	91,000	N	190,000	C	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
DICHLOROBENZENE, 1,2-	95-50-1	3,800	N	10,000	C	10,000	C
DICHLOROBENZENE, 1,3-	541-73-1	6,600	G	10,000	C	10,000	C
DICHLOROBENZENE, P-	106-46-7	750	G	3,300	G	190,000	C
DICHLOROBENZIDINE, 3,3'-	91-94-1	40	G	180	G	190,000	C
DICHLORODIFLUORO- METHANE (FREON 12)	75-71-8	3,800	N	10,000	C	10,000	C
DICHLOROETHANE, 1,1-	75-34-3	200	N	1,000	N	1,200	N
DICHLOROETHANE, 1,2-	107-06-2	12	N	63	N	73	N
DICHLOROETHYLENE, 1,1-	75-35-4	6.4	N	33	N	38	N
DICHLOROETHYLENE, CIS- 1,2-	156-59-2	670	N	1,900	N	2,100	N
DICHLOROETHYLENE, TRANS-1,2-	156-60-5	1,300	N	3,700	N	4,300	N
DICHLOROMETHANE (METHYLENE CHLORIDE)	75-09-2	680	N	3,500	N	4,000	N
DICHLOROPHENOL, 2,4-	120-83-2	660	G	8,400	G	190,000	C
DICHLOROPHENOXYACETIC ACID, 2,4- (2,4-D)	94-75-7	2,200	G	28,000	G	190,000	C
DICHLOROPROPANE, 1,2-	78-87-5	31	N	160	N	180	N
DICHLOROPROPENE, 1,3-	542-75-6	80	N	410	N	470	N
DICHLOROPROPIONIC ACID (DALAPON), 2,2-	75-99-0	2,000	N	5,500	N	6,300	N
DICHLORVOS	62-73-7	62	G	270	G	190,000	C
DICYCLOPENTADIENE	77-73-6	6,600	G	84,000	G	190,000	C
DIELDRIN	60-57-1	1.1	G	5	G	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
DIETHYL PHTHALATE	84-66-2	10,000	C	10,000	C	10,000	C
DIFLUBENZURON	35367-38-5	4,400	G	56,000	G	190,000	C
DIMETHOATE	60-51-5	44	G	560	G	190,000	C
DIMETHOXYBENZIDINE, 3,3-	119-90-4	1,300	G	5,700	G	190,000	C
DIMETHYLAMINOAZO-BENZENE, P-	60-11-7	3.9	G	17	G	190,000	C
DIMETHYLANILINE, N,N-	121-69-7	440	G	5,600	G	10,000	C
DIMETHYLBENZIDINE, 3,3-	119-93-7	1.9	G	8.6	G	10,000	C
DIMETHYLPHENOL, 2,4-	105-67-9	4,400	G	10,000	C	10,000	C
DINITROBENZENE, 1,3-	99-65-0	22	G	280	G	190,000	C
DINITROPHENOL, 2,4-	51-28-5	440	G	5,600	G	190,000	C
DINITROTOLUENE, 2,4-	121-14-2	58	G	260	G	190,000	C
DINITROTOLUENE, 2,6- (2,6-DNT)	606-20-2	220	G	2,800	G	190,000	C
DINOSEB	88-85-7	220	G	2,800	G	190,000	C
DIOXANE, 1,4-	123-91-1	41	N	210	N	240	N
DIPHENAMID	957-51-7	6,600	G	84,000	G	190,000	C
DIPHENYLAMINE	122-39-4	5,500	G	70,000	G	190,000	C
DIPHENYLHYDRAZINE, 1,2-	122-66-7	22	G	99	G	190,000	C
DIQUAT	85-00-7	480	G	6,200	G	190,000	C
DISULFOTON	298-04-4	2.7	N	7.6	N	8.7	N
DIURON	330-54-1	440	G	5,600	G	190,000	C
ENDOSULFAN	115-29-7	1,300	G	17,000	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL—(Continued)
A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
ENDOSULFAN I (ALPHA)	959-98-8	1,300	G	17,000	G	190,000	C
ENDOSULFAN II (BETA)	33213-65-9	1,300	G	17,000	G	190,000	C
ENDOSULFAN SULFATE	1031-07-8	1,300	G	17,000	G	190,000	C
ENDOTHALL	145-73-3	4,400	G	56,000	G	190,000	C
ENDRIN	72-20-8	66	G	840	G	190,000	C
EPICHLOROHYDRIN	106-89-8	19	N	53	N	60	N
ETHEPHON	16672-87-0	1,100	G	14,000	G	190,000	C
ETHION	563-12-2	110	G	1,400	G	10,000	C
ETHOXYETHANOL, 2- (EGEE)	110-80-5	3,800	N	10,000	C	10,000	C
ETHYL ACETATE	141-78-6	10,000	C	10,000	C	10,000	C
ETHYL ACRYLATE	140-88-5	23	N	120	N	140	N
ETHYL BENZENE	100-41-4	10,000	C	10,000	C	10,000	C
ETHYL DIPROPYLTHIOCARBAMATE, S- (EPTC)	759-94-4	5,500	G	10,000	C	10,000	C
ETHYL ETHER	60-29-7	10,000	C	10,000	C	10,000	C
ETHYL METHACRYLATE	97-63-2	20,000	G	190,000	C	190,000	C
ETHYLENE GLYCOL	107-21-1	10,000	C	10,000	C	10,000	C
ETHYLENE THIOUREA (ETU)	96-45-7	18	G	220	G	190,000	C
ETHYLP-NITROPHENYL PHENYLPHOSPHOROTHIOATE	2104-64-5	2.2	G	28	G	190,000	C
FENAMIPHOS	22224-92-6	55	G	700	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

250-115

(285849) No. 327 Feb. 02

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
FENVALERATE (PYDRIN)	51630-58-1	5,500	G	10,000	C	10,000	C
FLUOMETURON	2164-17-2	2,900	G	36,000	G	190,000	C
FLUORANTHENE	206-44-0	8,800	G	110,000	G	190,000	C
FLUORENE	86-73-7	8,800	G	110,000	G	190,000	C
FLUOROTRICHORO- METHANE (FREON 11)	75-69-4	10,000	C	10,000	C	10,000	C
FONOFOS	944-22-9	140	N	380	N	440	N
FORMALDEHYDE	50-00-0	24	N	130	N	150	N
FORMIC ACID	64-18-6	10,000	C	10,000	C	10,000	C
FOSETYL-AL	39148-24-8	190,000	C	190,000	C	190,000	C
FURAN	110-00-9	220	G	2,800	G	10,000	C
FURFURAL	98-01-1	660	G	2,600	N	3,000	N
GLYPHOSATE	1071-83-6	22,000	G	190,000	C	190,000	C
HEPTACHLOR	76-44-8	4	G	18	G	190,000	C
HEPTACHLOR EPOXIDE	1024-57-3	2	G	8.7	G	190,000	C
HEXACHLOROBENZENE	118-74-1	11	G	50	G	190,000	C
HEXACHLOROBUTADIENE	87-68-3	44	G	560	G	10,000	C
HEXACHLOROCYCLO- PENTADIENE	77-47-4	1,300	G	10,000	C	10,000	C
HEXACHLOROETHANE	67-72-1	220	G	2800	G	190,000	C
HEXANE	110-54-3	3,800	N	10,000	C	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
HEXYTHIAZOX (SAVEY)	78587-05-0	5,500	G	70,000	G	190,000	C
HYDRAZINE/HYDRAZINE SULFATE	302-01-2	0.065	N	0.34	N	0.39	N
HYDROQUINONE	123-31-9	8,800	G	110,000	G	190,000	C
INDENO[1,2,3-CD]PYRENE	193-39-5	25	G	110	G	190,000	C
IPRODIONE	36734-19-7	8,800	G	110,000	G	190,000	C
ISOBUTYL ALCOHOL	78-83-1	10,000	C	10,000	C	10,000	C
ISOPHORONE	78-59-1	10,000	C	10,000	C	10,000	C
KEPONE	143-50-0	1.1	G	5	G	190,000	C
MALATHION	121-75-5	1,400	N	4,000	N	4,600	N
MALEIC HYDRAZIDE	123-33-1	110,000	G	190,000	C	190,000	C
MANEB	12427-38-2	1,100	G	14,000	G	190,000	C
MERPHOS OXIDE	78-48-8	6.6	G	84	G	10,000	C
METHACRYLONITRILE	126-98-7	13	N	37	N	43	N
METHAMIDOPHOS	10265-92-6	11	G	140	G	190,000	C
METHANOL	67-56-1	10,000	C	10,000	C	10,000	C
METHOMYL	16752-77-5	5,500	G	70,000	G	190,000	C
METHOXYCHLOR	72-43-5	1,100	G	14,000	G	190,000	C
METHOXYETHANOL, 2-	109-86-4	220	G	1,100	N	1,200	N
METHYL ACETATE	79-20-9	10,000	C	10,000	C	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

250-117

(285851) No. 327 Feb. 02

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
METHYL ACRYLATE	96-33-3	6,600	G	10,000	C	10,000	C
METHYL CHLORIDE	74-87-3	180	N	920	N	1,000	N
METHYL ETHYL KETONE	78-93-3	10,000	C	10,000	C	10,000	C
METHYL ISOBUTYL KETONE	108-10-1	1,500	N	4,300	N	4,900	N
METHYL METHACRYLATE	80-62-6	10,000	C	10,000	C	10,000	C
METHYL METHANESULFONATE	66-27-3	180	G	800	G	190,000	C
METHYL PARATHION	298-00-0	17	N	48	N	55	N
METHYL STYRENE (MIXED ISOMERS)	25013-15-4	1,300	G	17,000	G	190,000	C
METHYL TERT-BUTYL ETHER (MTBE)	1634-04-4	620	G	3,200	N	3,700	N
METHYLENE BIS(2-CHLOROANILINE), 4,4'-	101-14-4	140	G	610	G	190,000	C
METHYLNAPHTHALENE, 2-	91-57-6	4,400	G	10,000	C	10,000	C
METHYLSTYRENE, ALPHA	98-83-9	15,000	G	190,000	C	190,000	C
NAPHTHALENE	91-20-3	4,400	G	56,000	G	190,000	C
NAPHTHYLAMINE, 1-	134-32-7	9.9	G	44	G	190,000	C
NAPHTHYLAMINE, 2-	91-59-8	9.9	G	44	G	190,000	C
NAPROPAMIDE	15299-99-7	22,000	G	190,000	C	190,000	C
NITROANILINE, M-	99-09-2	13	G	160	G	190,000	C
NITROANILINE, O-	88-74-4	13	G	160	G	190,000	C
NITROANILINE, P-	100-01-6	13	G	160	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
NITROBENZENE	98-95-3	110	G	1,400	G	10,000	C
NITROPHENOL, 2-	88-75-5	1,800	G	22,000	G	190,000	C
NITROPHENOL, 4-	100-02-7	1,800	G	22,000	G	190,000	C
NITROPROPANE, 2-	79-46-9	0.12	N	0.61	N	0.70	N
NITROSODIETHYLAMINE, N-	55-18-5	0.0073	N	0.038	N	0.044	N
NITROSODIMETHYLAMINE, N-	62-75-9	0.023	N	0.12	N	0.13	N
NITROSO-DI-N- BUTYLAMINE, N-	924-16-3	3.3	G	15	G	10,000	C
NITROSODI-N- PROPYLAMINE, N-	621-64-7	2.6	G	11	G	10,000	C
NITROSODIPHENYLAMINE, N-	86-30-6	3,700	G	16,000	G	190,000	C
NITROSO-N-ETHYLUREA, N-	759-73-9	0.13	G	0.57	G	190,000	C
OCTYL PHTHALATE, DI-N-	117-84-0	4,400	G	10,000	C	10,000	C
OXAMYL (VYDATE)	23135- 22-0	5,500	G	70,000	G	190,000	C
PARATHION	56-38-2	1,300	G	10,000	C	10,000	C
PCB-1016 (AROCOR)	12674- 11-2	15	G	200	G	10,000	C
PCB-1221 (AROCOR)	11104- 28-2	36	G	160	G	10,000	C
PCB-1232 (AROCOR)	11141- 16-5	36	G	160	G	10,000	C
PCB-1242 (AROCOR)	53469- 21-9	36	G	160	G	10,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
PCB-1248 (AROCOLOR)	12672-29-6	9.9	G	44	G	10,000	C
PCB-1254 (AROCOLOR)	11097-69-1	4.4	G	44	G	10,000	C
PCB-1260 (AROCOLOR)	11096-82-5	30	G	130	G	190,000	C
PEBULATE	1114-71-2	10,000	C	10,000	C	10,000	C
PENTACHLOROBENZENE	608-93-5	180	G	2,200	G	190,000	C
PENTACHLORONITRO-BENZENE	82-68-8	69	G	310	G	190,000	C
PENTACHLOROPHENOL	87-86-5	150	G	660	G	190,000	C
PHENACETIN	62-44-2	8,100	G	36,000	G	190,000	C
PHENANTHRENE	85-01-8	66,000	G	190,000	C	190,000	C
PHENOL	108-95-2	130,000	G	190,000	C	190,000	C
PHENYLENEDIAMINE, M-	108-45-2	1,300	G	17,000	G	190,000	C
PHENYLPHENOL, 2-	90-43-7	9,200	G	41,000	G	190,000	C
PHORATE	298-02-2	13	N	37	N	43	N
PHTHALIC ANHYDRIDE	85-44-9	190,000	C	190,000	C	190,000	C
PICLORAM	1918-02-1	15,000	G	190,000	C	190,000	C
PRONAMIDE	23950-58-5	17,000	G	190,000	C	190,000	C
PROPANIL	709-98-8	1,100	G	14,000	G	190,000	C
PROPHAM	122-42-9	4,400	G	56,000	G	190,000	C
PROPYLBENZENE, N-	103-65-1	8,800	G	10,000	C	10,000	C
PROPYLENE OXIDE	75-56-9	75	G	330	G	510	N

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
PYRENE	129-00-0	6,600	G	84,000	G	190,000	C
PYRIDINE	110-86-1	67	N	190	N	210	N
QUINOLINE	91-22-5	1.5	G	6.6	G	10,000	C
QUIZALOFOP (ASSURE)	76578-14-8	2,000	G	25,000	G	190,000	C
RONNEL	299-84-3	11,000	G	140,000	G	190,000	C
SIMAZINE	122-34-9	150	G	660	G	190,000	C
STRYCHNINE	57-24-9	66	G	840	G	190,000	C
STYRENE	100-42-5	10,000	C	10,000	C	10,000	C
TEBUTHIURON	34014-18-1	15,000	G	190,000	C	190,000	C
TERBACIL	5902-51-2	2,900	G	36,000	G	190,000	C
TERBUFOS	13071-79-9	1.7	N	4.6	N	5.3	N
TETRACHLOROBENZENE, 1,2,4,5-	95-94-3	66	G	840	G	190,000	C
TETRACHLORODIBENZO-P- DIOXIN, 2,3,7,8- (TCDD)	1746-01-6	0.00012	G	0.00053	G	190,000	C
TETRACHLOROETHANE, 1,1,1,2-	630-20-6	690	G	3,100	G	190,000	C
TETRACHLOROETHANE, 1,1,2,2-	79-34-5	5.5	N	28	N	33	N
TETRACHLOROETHYLENE (PCE)	127-18-4	340	G	1,500	G	3,300	N
TETRACHLOROPHENOL, 2,3,4,6-	58-90-2	6,600	G	84,000	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC
REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
TETRAETHYL LEAD	78-00-2	0.022	G	0.28	G	10,000	C
TETRAETHYLDITHIOPYRO- PHOSPHATE	3689- 24-5	33	N	92	N	110	N
THIOFANOX	39196- 18-4	66	G	840	G	190,000	C
THIRAM	137-26-8	1,100	G	14,000	G	190,000	C
TOLUENE	108-88-3	7,600	N	10,000	C	10,000	C
TOLUIDINE, M-	108-44-1	75	G	330	G	10,000	C
TOLUIDINE, O-	95-53-4	75	G	330	G	10,000	C
TOLUIDINE, P-	106-49-0	94	G	420	G	190,000	C
TOXAPHENE	8001- 35-2	16	G	72	G	190,000	C
TRIALATE	2303- 17-5	2,900	G	36,000	G	190,000	C
TRIBROMOMETHANE (BROMOFORM)	75-25-2	290	N	1,500	N	1,700	N
TRICHLORO- 1,2,2- TRIFLUOROETHANE, 1,1,2-	76-13-1	190,000	C	190,000	C	190,000	C
TRICHLOROBENZENE, 1,2,4-	120-82-1	2,200	G	10,000	C	10,000	C
TRICHLOROBENZENE, 1,3,5-	108-70-3	1,300	G	17,000	G	190,000	C
TRICHLOROETHANE, 1,1,1-	71-55-6	10,000	G	10,000	C	10,000	C
TRICHLOROETHANE, 1,1,2-	79-00-5	20	N	100	N	120	N
TRICHLOROETHYLENE (TCE)	79-01-6	190	N	970	N	1,100	N
TRICHLOROPHENOL, 2,4,5-	95-95-4	22,000	G	190,000	C	190,000	C
TRICHLOROPHENOL, 2,4,6-	88-06-2	66	G	840	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL—(Continued)

A. Direct Contact Numeric Values

REGULATED SUBSTANCE	CASRN	Residential 0-15 feet		Non-Residential			
				Surface Soil 0-2 feet		Subsurface Soil 2-15 feet	
TRICHLOROPHENOXYACETIC ACID, 2,4,5- (2,4,5-T)	93-76-5	2,200	G	28,000	G	190,000	C
TRICHLOROPHENOXY-PROPIONIC ACID, 2,4,5- (2,4,5-TP)(SILVEX)	93-72-1	1,800	G	22,000	G	190,000	C
TRICHLOROPROPANE, 1,1,2-	598-77-6	1,100	G	10,000	C	10,000	C
TRICHLOROPROPANE, 1,2,3-	96-18-4	0.16	N	0.82	N	0.95	N
TRICHLOROPROPENE, 1,2,3-	96-19-5	1,100	G	10,000	C	10,000	C
TRIFLURALIN	1582-09-8	1,700	G	10,000	G	190,000	C
TRIMETHYLBENZENE, 1,3,4- (TRIMETHYLBENZENE, 1,2,4-)	95-63-6	110	N	320	N	360	N
TRIMETHYLBENZENE, 1,3,5-	108-67-8	110	N	320	N	360	N
TRINITROTOLUENE, 2,4,6-	118-96-7	110	G	1,400	G	190,000	C
VINYL ACETATE	108-05-4	3,800	N	10,000	C	10,000	C
VINYL BROMIDE (BROMOETHENE)	593-60-2	160	G	720	G	190,000	C
VINYL CHLORIDE	75-01-4	12	G	53	G	220	N
WARFARIN	81-81-2	66	G	840	G	190,000	C
XYLENES (TOTAL)	1330-20-7	8,000	N	10,000	C	10,000	C
ZINEB	12122-67-7	11,000	G	140,000	G	190,000	C

All concentrations in mg/kg

G - Ingestion

H - Inhalation

C - Cap

APPENDIX A
TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹

REGULATED SUBSTANCE	CASRN	Used Aquifers												Non-Use Aquifers				Soil Buffer Distance (feet)
		TDS ≤ 2500						TDS > 2500						Non-Use Aquifers				
		Residential		Non-Residential		Generic Value	Residential		Non-Residential		Generic Value	Residential		Non-Residential		Generic Value		
		100 X GW MSC	100 X Value	100 X GW MSC	100 X Value		100 X GW MSC	100 X Value	100 X GW MSC	100 X Value		100 X GW MSC	100 X Value	100 X GW MSC	100 X Value			
ACENAPHTHENE	83-32-9	220	2,700 E	380	4,700 E	380	4,700 E	380	4,700 E	380	4,700 E	380	4,700 E	380	4,700 E	15		
ACENAPHTHYLENE	208-96-8	220	2,500 E	610	6,900 E	1,600	1,800 E	1,600	18,000 E	1,600	18,000 E	1,600	18,000 E	1,600	18,000 E	15		
ACEPHATE	30560-19-1	7.6	0.9 E	30	3.6 E	760	90	3,000	360 E	7.6	0.9 E	30	3.6 E	7.6	0.9 E	NA		
ACETALDEHYDE	75-07-0	1.9	0.23 E	5.2	0.63 E	190	23	520	63 E	1.9	0.23 E	5.2	0.63 E	1.9	0.23 E	NA		
ACETONE	67-64-1	370	41 E	1,000	110 E	10,000	4,100 E	10,000	10,000 C	3,700	410 E	10,000	1,100 E	10,000	1,100 E	NA		
ACETONITRILE	75-05-8	17	1.9 E	35	3.9 E	1,700	190	3,500	390 E	170	19 E	350	39 E	170	19 E	NA		
ACETOPHENONE	98-86-2	370	200 E	1,000	540 E	10,000	10,000 C	10,000	10,000 C	370	200 E	1,000	540 E	370	200 E	NA		
ACETYLAMINOFLUORENE, 2-(2AAF)	53-96-3	0.017	0.07 E	0.068	0.28 E	1.7	7 E	6.8	28 E	1.7	7 E	6.8	28 E	1.7	7 E	20		
ACROLEIN	107-02-8	0.0035	0.0062 E	0.012	0.0014 E	0.55	0.062 E	1.2	0.14 E	0.55	0.062 E	1.2	0.014 E	0.55	0.062 E	NA		
ACRYLAMIDE	79-06-1	0.0033	0.00057 E	0.014	0.0024 E	0.33	0.057 E	1.4	0.24 E	0.0033	0.00057 E	0.014	0.0024 E	0.0033	0.00057 E	NA		
ACRYLIC ACID	79-10-7	0.28	0.051 E	0.58	0.11 E	28	5.1 E	58	11 E	28	5.1 E	58	11 E	28	5.1 E	NA		
ACRYLONITRILE	107-13-1	0.063	0.0087 E	0.27	0.037 E	6.3	0.87 E	27	3.7 E	6.3	0.87 E	27	3.7 E	6.3	0.87 E	NA		
ALACHLOR	15972-60-8	0.2	0.077 E	0.2	0.077 E	20	7.7 E	20	7.7 E	0.2	0.077 E	0.2	0.077 E	0.2	0.077 E	NA		
ALDICARB	116-06-3	0.7	0.12 E	0.7	0.12 E	70	12 E	70	12 E	70	12 E	70	12 E	70	12 E	NA		
ALDRIN	309-00-2	0.00087	0.1 E	0.0037	0.44 E	0.087	10 E	0.37	44 E	0.087	10 E	0.37	44 E	10	44 E	10		
ALLYL ALCOHOL	107-18-6	4.9	0.58 E	10	1.2 E	490	58 E	1,000	120 E	490	58 E	1,000	120 E	1,000	120 E	NA		
AMINOBIIPHENYL, 4-	92-67-1	0.0031	0.0012 E	0.012	0.0046 E	0.31	0.12 E	1.2	0.46 E	0.31	0.12 E	1.2	4.6 E	1.2	4.6 E	NA		
AMITROLE	61-82-5	0.07	0.029 E	0.28	0.12 E	7	2.9 E	28	12 E	7	2.9 E	28	120 E	28	120 E	NA		
AMMONIA	7664-41-7	3,000	360 E	3,000	360 E	10,000	10,000 C	10,000	10,000 C	3,000	360 E	3,000	360 E	3,000	360 E	NA		
AMMONIUM SULFAMATE	7773-06-0	200	24 E	200	24 E	20,000	2,400 E	20,000	2,400 E	200	24 E	200	24 E	200	24 E	NA		
ANILINE	62-53-3	0.28	0.16 E	0.58	0.34 E	28	16 E	58	34 E	0.28	0.16 E	0.58	0.34 E	0.58	0.34 E	NA		
ANTHRACENE	120-12-7	6.6	350 E	6.6	350 E	6.6	350 E	6.6	350 E	6.6	350 E	6.6	350 E	6.6	350 E	10		
ATRAZINE	1912-24-9	0.3	0.13 E	0.3	0.13 E	30	13 E	30	13 E	0.3	0.13 E	0.3	0.13 E	0.3	0.13 E	NA		
BAYGON (PROPOXUR)	114-26-1	0.3	0.057 E	0.3	0.057 E	30	5.7 E	30	5.7 E	30	5.7 E	30	5.7 E	30	5.7 E	NA		
BENOMYL	17804-35-2	180	880 E	200	970 E	200	970 E	200	970 E	180	880 E	200	970 E	200	970 E	20		
BENTAZON	25057-89-4	110	16 E	310	45 E	11,000	1,600 E	31,000	4,500 E	110	16 E	310	45 E	110	16 E	NA		

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
 B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Non-Use Aquifers				Soil Buffer Distance (feet)		
		TDS ≤ 2500						TDS > 2500												
		Residential			Non-Residential			Residential			Non-Residential			Residential			Non-Residential			
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value			
BENZENE	71-43-2	0.5	0.13 E	0.5	0.13 E	50	13 E	50	13 E	50	13 E	50	13 E	50	13 E	50	13 E	NA		
BENZIDINE	92-87-5	0.00029	0.38 E	0.0011	1.5 E	0.029	38 E	0.11	150 E	0.29	380 E	1.1	1,500 E	5	1,500 E	5	1,500 E	5		
BENZOLANTRACENE	56-55-3	0.09	79 E	0.34	320 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E	5		
BENZOLAPYRENE	50-32-8	0.02	46 E	0.02	46 E	0.38	860 E	0.38	860 E	0.38	860 E	0.38	860 E	0.38	860 E	0.38	860 E	5		
BENZOBIFLUORANTHENE	205-99-2	0.09	120 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	5		
BENZOCHELPERYLENE	191-24-2	0.026	180 E	0.026	180 E	0.026	180 E	0.026	180 E	0.026	180 E	0.026	180 E	0.026	180 E	0.026	180 E	5		
BENZOKJFLUORANTHENE	207-08-4	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	5		
BENZONITRILE	65-85-0	15,000	2,900 E	41,000	7,800 E	190,000	52,000 E	190,000	52,000 E	190,000	52,000 E	190,000	52,000 E	15,000	2,900 E	41,000	7,800 E	NA		
BENZOTRICHLORIDE	98-07-7	0.0051	0.012 E	0.02	0.048 E	0.51	1.2 E	2	4.8 E	5.1	12 E	20	48 E	30	48 E	30	48 E	30		
BENZYL ALCOHOL	100-51-6	1.100	400 E	3.100	1,100 E	10,000	10,000 E	10,000	10,000 E	10,000	10,000 E	10,000	10,000 E	1,100	400 E	3,100	1,100 E	NA		
BENZYL CHLORIDE	100-44-7	0.087	0.051 E	0.37	0.22 E	8.7	5.1 E	37	22 E	8.7	5.1 E	37	22 E	8.7	5.1 E	37	22 E	NA		
BHC, ALPHA	319-84-6	0.01	0.046 E	0.041	0.19 E	1	4.6 E	4.1	19 E	10	46 E	41	190 E	20	46 E	41	190 E	20		
BHC, BETA	319-85-7	0.037	0.22 E	0.14	0.82 E	3.7	22 E	10	59 E	10	59 E	10	59 E	10	59 E	10	59 E	15		
BHC, DELTA	319-86-8	2.2	11 E	6.1	30 E	220	1100 E	610	3,000 E	800	3,900 E	800	3,900 E	800	3,900 E	800	3,900 E	20		
BHC, GAMMA (LINDANE)	58-89-9	0.02	0.072 E	0.02	0.072 E	2	7.2 E	2	7.2 E	20	72 E	20	72 E	20	72 E	20	72 E	20		
BIPHENYL, 1,1-	92-52-4	180	790 E	510	2,200 E	720	3,100 E	720	3,100 E	720	3,100 E	720	3,100 E	720	3,100 E	720	3,100 E	20		
BIS(2-CHLOROETHYL)ETHER	111-44-4	0.013	0.0039 E	0.055	0.017 E	1.3	0.39 E	5.5	1.7 E	1.3	0.39 E	5.5	1.7 E	1.3	0.39 E	5.5	1.7 E	NA		
BIS(2-CHLOROISOPROPYL)ETHER	108-60-1	30	8 E	30	8 E	3,000	800 E	3,000	800 E	3,000	800 E	3,000	800 E	3,000	800 E	3,000	800 E	NA		
BISCHLOROMETHYL ETHER	542-88-1	0.000069	0.00001 E	0.00029	0.000044 E	0.0069	0.001 E	0.029	0.0044 E	0.0069	0.001 E	0.029	0.0044 E	0.0069	0.001 E	0.029	0.0044 E	NA		
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	0.6	130 E	0.6	130 E	29	6,300 E	29	6,300 E	29	6,300 E	29	6,300 E	29	6,300 E	29	6,300 E	10		
BISPHENOL A	80-05-7	180	700 E	510	2,000 E	12,000	46,000 E	12,000	46,000 E	12,000	46,000 E	12,000	46,000 E	12,000	46,000 E	12,000	46,000 E	20		
BROMACIL	314-40-9	8	2 E	8	2 E	800	200 E	800	200 E	8	2 E	8	2 E	8	2 E	8	2 E	NA		
BROMOCHLOROMETHANE	74-97-5	6	1.6 E	6	1.6 E	900	160 E	900	160 E	9	1.6 E	9	1.6 E	9	1.6 E	9	1.6 E	NA		
BROMODICHLOROMETHANE	75-27-4	10	3.4 E	10	3.4 E	1,000	340 E	1,000	340 E	10	3.4 E	10	3.4 E	10	3.4 E	10	3.4 E	NA		
BROMOMETHANE	74-83-9	1	0.54 E	1	0.54 E	100	54 E	100	54 E	100	54 E	100	54 E	100	54 E	100	54 E	NA		
BROMOXYNIL	1689-84-5	73	63 E	200	170 E	7,300	6,300 E	13,000	11,000 E	73	63 E	200	170 E	73	63 E	200	170 E	NA		
BROMOXYNIL OCTANOATE	1689-99-2	8	360 E	8	360 E	8	360 E	8	360 E	8	360 E	8	360 E	8	360 E	8	360 E	15		

¹For other options see § 250.308

All concentrations are mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL.
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers														Soil		
		TDS ≤ 2500					TDS > 2500					Non-Use Aquifers						
		Residential		Non-Residential		Residential	Non-Residential		Residential		Non-Residential		Residential		Non-Residential			
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value				
BUTADIENE, 1,3-	106-99-0	0.015	0.0002 E	0.065	0.027 E	1.5	0.62 E	9.700	1,200 E	10,000	2,400 E	970	120 E	2,000	240 E	NA		
BUTYL ALCOHOL, N-	71-36-3	97	12 E	200	24 E	9,700	1,200 E	10,000	2,400 E	970	120 E	2,000	240 E	970	120 E	2,000	240 E	NA
BUTYLATE	2008-41-5	35	51 E	35	51 E	3,500	5,100 E	3,500	5,100 E	35	51 E	35	51 E	35	51 E	35	51 E	30
BUTYLBENZENE, N-	104-51-8	150	950 E	410	2,600 E	1,500	9,500 E	1,500	9,500 E	150	950 E	410	2,600 E	150	950 E	410	2,600 E	15
BUTYLBENZENE, SEC-	135-98-8	150	350 E	410	960 E	1,700	4,000 E	1,700	4,000 E	150	350 E	410	960 E	150	350 E	410	960 E	30
BUTYLBENZENE, TERT-	98-06-4	150	270 E	410	740 E	3,000	5,400 E	3,000	5,400 E	150	270 E	410	740 E	150	270 E	410	740 E	30
BUTYLBENZYL PHTHALATE	85-68-7	270	10,000 C	270	10,000 C	270	10,000 C	270	10,000 C	270	10,000 C	270	10,000 C	270	10,000 C	270	10,000 C	10
CAPTAN	133-06-2	19	12 E	50	31 E	50	31 E	50	31 E	50	31 E	50	31 E	50	31 E	50	31 E	NA
CARBARYL	63-25-2	70	41 E	70	41 E	7,000	4,100 E	7,000	4,100 E	70	41 E	70	41 E	70	41 E	70	41 E	NA
CARBAZOLE	86-74-8	33	21 E	13	83 E	120	760 E	120	760 E	120	760 E	120	760 E	120	760 E	120	760 E	15
CARBOFURAN	1563-66-2	4	0.87 E	4	0.87 E	400	87 E	400	87 E	4	0.87 E	4	0.87 E	4	0.87 E	4	0.87 E	NA
CARBON DISULFIDE	75-15-0	190	160 E	410	350 E	10,000	10,000 C	10,000	10,000 C	190	160 E	410	350 E	190	160 E	410	350 E	NA
CARBON TETRACHLORIDE	56-23-5	0.5	0.26 E	0.5	0.26 E	50	26 E	50	26 E	50	26 E	50	26 E	50	26 E	50	26 E	NA
CARBOXIN	5234-68-4	70	53 E	70	53 E	7,000	5,300 E	7,000	5,300 E	70	53 E	70	53 E	70	53 E	70	53 E	NA
CHLORAMBEN	133-90-4	10	1.6 E	10	1.6 E	1,000	1,600 E	1,000	1,600 E	10	1.6 E	10	1.6 E	10	1.6 E	10	1.6 E	NA
CHLORDANE	57-74-9	0.2	49 E	0.2	49 E	56	26 E	56	26 E	56	26 E	56	26 E	56	26 E	56	26 E	NA
CHLORO-1,1-DIFLUOROETHANE, 1-	75-68-3	14,000	2,300 E	29,000	4,800 E	140,000	23,000 E	140,000	23,000 E	14,000	2,300 E	29,000	4,800 E	14,000	2,300 E	29,000	4,800 E	NA
CHLORO-1-PROPENE, 3- (ALLYL CHLORIDE)	107-05-1	0.28	0.065 E	0.58	0.13 E	28	6.5 E	58	13 E	28	6.5 E	58	13 E	28	6.5 E	58	13 E	NA
CHLORODACETOPHENONE, 2-	532-27-4	0.031	0.0093 E	0.088	0.026 E	3.1	0.93 E	8.8	2.6 E	3.1	0.93 E	8.8	2.6 E	3.1	0.93 E	8.8	2.6 E	NA
CHLOROANILINE, P-	106-47-8	15	19 E	41	52 E	1,500	1,900 E	1,500	1,900 E	15	19 E	41	52 E	15	19 E	41	52 E	NA
CHLOROBENZENE	108-90-7	10	6.1 E	10	6.1 E	1,000	610 E	1,000	610 E	10	6.1 E	1,000	610 E	1,000	610 E	1,000	610 E	NA
CHLOROBENZILATE	510-15-6	0.24	1.6 E	0.94	6.3 E	24	160 E	94	630 E	24	160 E	94	630 E	24	160 E	94	630 E	15
CHLOROBUTANE, 1-	109-69-3	1,500	2,300 E	4,100	6,400 E	10,000	10,000 C	10,000	10,000 C	1,500	2,300 E	4,100	6,400 E	1,500	2,300 E	4,100	6,400 E	30
CHLORODIBROMOMETHANE	124-48-1	10	3.2 E	10	3.2 E	1,000	320 E	1,000	320 E	10	3.2 E	1,000	320 E	1,000	320 E	1,000	320 E	NA
CHLORODIFLUOROMETHANE	75-45-6	10	2.6 E	10	2.6 E	1,000	260 E	1,000	260 E	10	2.6 E	1,000	260 E	10	2.6 E	1,000	260 E	NA
CHLOROETHANE	75-00-3	23	5 E	90	19 E	2,300	500 E	900	1,900 E	230	50 E	900	1,900 E	230	50 E	900	1,900 E	NA
CHLOROFORM	67-66-3	10	2.5 E	10	2.5 E	1,000	250 E	1,000	250 E	10	2.5 E	1,000	250 E	10	2.5 E	1,000	250 E	NA

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil Buffer Distance (feet)	
		TDS ≤ 2500						TDS > 2500							
		Residential			Non-Residential			Residential			Non-Residential				
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value		
CHLORONAPHTHALENE, 2-	91-58-7	200	6,200 E	820	18,000 E	1,200	26,000 E	1,200	26,000 E	290	6,200 E	820	18,000 E	15	
CHLORONITROBENZENE, P-	100-00-5	3	4.9 E	14	18 E	370	490 E	1,200	1,800 E	4	5 E	14	18 E	N/A	
CHLORONITROBENZENE, 2-	95-57-8	4	4.4 E	4	4.4 E	400	440 E	400	440 E	4	4.4 E	4	4.4 E	N/A	
CHLOROPRENE	126-99-8	1	0.45 E	4	0.97 E	190	45 E	410	97 E	190	45 E	410	97 E	N/A	
CHLOROPROPANE, 2-	75-29-4	28	21 E	58	44 E	2,800	2,100 E	5,800	4,400 E	28	21 E	58	44 E	N/A	
CHLOROTHALONIL	1897-45-6	6	15 E	24	61 E	60	150 E	60	150 E	6	15 E	24	61 E	30	
CHLOROTOLUENE, O-	95-49-8	10	20 E	10	20 E	1,000	2,000 E	1,000	2,000 E	10	20 E	10	20 E	30	
CHLORPYRIFOS	2921-88-2	2	23 E	2	23 E	110	1,300 E	110	1,300 E	2	23 E	2	23 E	15	
CHLORSULFURON	64902-72-3	180	25 E	510	71 E	13,000	1,800 E	13,000	1,800 E	180	25 E	510	71 E	N/A	
CHLORTHAL-DIMETHYL (DCACTHAL) (DCPA)	1861-32-1	40	650 E	40	650 E	50	820 E	50	820 E	50	820 E	50	820 E	15	
CHRYSENE	218-01-9	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	5	
CRESOL(S)	1319-77-3	18	3.1 E	51	8.9 E	1,800	310 E	5,100	890 E	1,800	310 E	5,100	890 E	N/A	
CRESOL, O- (METHYLPHENOL, 2-)	95-48-7	180	64 E	510	180 E	10,000	6,400 E	10,000	10,000 C	10,000	6,400 E	10,000	10,000 C	N/A	
CRESOL, M (METHYLPHENOL, 3-)	108-39-4	180	36 E	510	100 E	10,000	3,600 E	10,000	10,000 C	10,000	3,600 E	10,000	10,000 C	N/A	
CRESOL, P (METHYLPHENOL, 4-)	106-44-5	18	4.2 E	51	12 E	1,800	420 E	5,100	1,200 E	18,000	4,200 E	51,000	12,000 E	N/A	
CRESOL, P-CHLORO-M-	59-50-7	18	37 E	51	110 E	1,800	3,700 E	5,100	11,000 E	18	37 E	51	110 E	30	
CROTONALDEHYDE	4170-30-3	0.0079	0.00090 E	0.034	0.0043 E	0.79	0.099 E	3.4	0.43 E	0.79	0.099 E	3.4	0.43 E	N/A	
CROTONALDEHYDE, TRANS-	123-73-9	0.0079	0.00090 E	0.034	0.0043 E	0.79	0.099 E	3.4	0.43 E	0.79	0.10 E	3.4	0.43 E	N/A	
CUMENE	98-82-8	110	780 E	230	1,600 E	5,000	10,000 C	5,000	10,000 C	5,000	10,000 C	5,000	10,000 C	15	
CYCLOHEXANONE	108-94-1	4,900	1,400 E	10,000	2,800 E	10,000	10,000 C	10,000	10,000 C	4,900	1,400 E	10,000	2,800 E	N/A	
CYFLUTHRIN	68359-37-5	0.1	33 E	0.1	33 E	0.1	33 E	0.1	33 E	0.1	33 E	0.1	33 E	10	
CYROMAZINE	66215-27-8	27	84 E	77	240 E	2,700	8,400 E	7,700	24,000 E	27	84 E	77	240 E	20	
DDD, 4,4'-	72-54-8	0.062	6.8 E	0.27	30 E	6.2	680 E	16	1,800 E	6.2	680 E	16	1,800 E	10	
DDT, 4,4'-	72-55-9	0.19	41 E	0.76	170 E	4	870 E	4	870 E	4	870 E	4	870 E	10	
DDT, 4,4'-	50-29-3	0.19	110 E	0.55	330 E	0.55	330 E	0.55	330 E	0.55	330 E	0.55	330 E	5	
DI(2-ETHYLHEXYL)ADIPATE	103-23-1	40	10,000 C	40	10,000 C	4,000	10,000 C	4,000	10,000 C	10,000	10,000 C	10,000	10,000 C	N/A	
DIALATE	2303-16-4	0.25	0.15 E	1	0.59 E	25	15 E	100	59 E	25	15 E	100	59 E	N/A	

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil
		TDS ≤ 2500						TDS > 2500						
		Residential			Non-Residential			Residential			Non-Residential			
		100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	
DIAMINOTOLUENE, 2,4-	95-80-7	0.021	0.0042 E	0.081	0.016 E	2.1	0.42 E	8.1	1.6 E	21	4.2 E	81	16 E	NA
DIAZINON	333-41-5	0.06	0.082 E	0.06	0.082 E	6	8.2 E	6	8.2 E	0.06	0.082 E	0.06	0.082 E	30
DIBENZ[O,A]ANTHRACENE	53-70-3	0.009	41 E	0.036	160 E	0.06	270 E	0.06	270 E	0.06	270 E	0.06	270 E	5
DIBROMO-3-CHLOROPROPANE, 1,2-	96-12-8	0.02	0.0092 E	0.02	0.0092 E	2	0.92 E	2	0.92 E	2	0.92 E	2	0.92 E	NA
DIBROMOBENZENE, 1,4-	106-37-6	37	150 E	100	410 E	2,000	8,200 E	2,000	8,200 E	37	150 E	100	410 E	20
DIBROMOMETHANE, 1,2- (ETHYLENE DIBROMIDE)	106-93-4	0.005	0.0012 E	0.005	0.0012 E	0.5	0.12 E	0.5	0.12 E	0.5	0.12 E	0.5	0.12 E	NA
DIBROMOMETHANE	74-95-3	9.7	3.7 E	20	7.7 E	970	370 E	2,000	770 E	970	370 E	2,000	770 E	NA
DIBUTYL PHTHALATE, N-	84-74-2	370	1,500 E	1,000	4,100 E	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	20
DICHLORO-2-BUTENE, 1,4-	764-41-0	0.0016	0.0009 E	0.0063	0.0039 E	0.16	0.09 E	0.63	0.39 E	0.0016	0.0009 E	0.0063	0.0039 E	NA
DICHLOROBENZENE, 1,2-	95-50-1	60	59 E	60	59 E	6,000	5,900 E	6,000	5,900 E	6,000	5,900 E	6,000	5,900 E	NA
DICHLOROBENZENE, 1,3-	541-73-1	60	61 E	60	61 E	6,000	6,100 E	6,000	6,100 E	6,000	6,100 E	6,000	6,100 E	NA
DICHLOROBENZENE, P-	106-46-7	7.5	10 E	7.5	10 E	750	1,000 E	750	1,000 E	750	1,000 E	750	1,000 E	30
DICHLOROBENZIDINE, 3,3'-	91-94-1	0.15	8.3 E	0.58	32 E	15	830 E	58	3,200 E	150	8,300 E	310	17,000 E	10
DICHLORODIFLUOROMETHANE (FREON 12)	75-71-8	100	100 E	100	100 E	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	NA
DICHLOROETHANE, 1,1-	75-34-3	2.7	0.65 E	11	2.7 E	270	65 E	1,100	270 E	27	6.5 E	110	27 E	NA
DICHLOROETHANE, 1,2-	107-06-2	0.5	0.1 E	0.5	0.1 E	50	10 E	50	10 E	5	1 E	5	1 E	NA
DICHLOROETHYLENE, 1,1-	75-35-4	0.7	0.19 E	0.7	0.19 E	70	19 E	70	19 E	7	1.9 E	7	1.9 E	NA
DICHLOROETHYLENE, CIS-1,2-	156-59-2	7	1.6 E	7	1.6 E	700	160 E	700	160 E	70	16 E	70	16 E	NA
DICHLOROETHYLENE, TRANS-1,2-	156-60-5	10	2.3 E	10	2.3 E	1,000	230 E	1,000	230 E	100	23 E	100	23 E	NA
DICHLOROMETHANE (METHYLENE CHLORIDE)	75-09-2	0.5	0.076 E	0.5	0.076 E	50	7.6 E	50	7.6 E	50	7.6 E	50	7.6 E	NA
DICHLOROPHENOL, 2,4-	120-83-2	2	1 E	2	1 E	200	100 E	200	100 E	2,000	1,000 E	2,000	1,000 E	NA
DICHLOROPHENOXACETIC ACID, 2,4- (2,4-D)	94-75-7	7	1.8 E	7	1.8 E	700	180 E	700	180 E	700	180 E	700	180 E	NA
DICHLOROPROPANE, 1,2-	78-87-5	0.5	0.11 E	0.5	0.11 E	50	11 E	50	11 E	5	1.1 E	5	1.1 E	NA
DICHLOROPROPENE, 1,3-	542-75-6	0.60	0.12 E	2.6	0.46 E	66	12 E	260	46 E	66	12 E	260	46 E	NA

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil
		TDS ≤ 2500						TDS > 2500						
		Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	
DICHLOROPROPIONIC ACID (DALAPON), 2,2-	75-99-4	20	5.3 E	20	5.3 E	2,000	530 E	2,000	530 E	2,000	530 E	2,000	530 E	NA
DICHLOROVOS	62-73-7	0.052	0.012 E	0.22	0.052 E	5.2	1.2 E	22	5.2 E	0.052	0.012 E	0.22	0.052 E	NA
DICYCLOPENTADIENE	77-73-6	0.055	0.012 E	0.12	0.26 E	5.5	12 E	26	26 E	0.055	0.012 E	0.12	0.26 E	30
DIELDRIN	60-57-1	0.0041	0.11 E	0.016	0.44 E	0.41	11 E	1.6	44 E	4.1	110 E	16	440 E	15
DIETHYL PHTHALATE	84-66-2	500	160 E	500	160 E	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	NA
DIFLUBENZURON	35367-38-5	20	52 E	20	52 E	20	52 E	20	52 E	20	52 E	20	52 E	20
DIMETHOATE	60-51-5	0.73	0.28 E	2	0.77 E	73	28 E	200	77 E	730	280 E	2,000	770 E	NA
DIMETHOXYBENZIDINE, 3,3-	119-90-4	4.7	16 E	19	64 E	470	1,600 E	1,900	6,400 E	4,700	16,000 E	6,000	20,000 E	20
DIMETHYLAMINOAZOBENZENE, P-	60-11-7	0.014	0.037 E	0.057	0.15 E	1.4	3.7 E	5.7	15 E	14	37 E	57	150 E	20
DIMETHYLANILINE, N,N-	121-69-7	7.3	4.1 E	20	11 E	730	410 E	2,000	1,100 E	730	410 E	2,000	1,100 E	NA
DIMETHYLPHENOL, 3,3-	119-93-7	0.0072	0.4 E	0.028	1.5 E	0.72	40 E	2.8	150 E	7.2	400 E	28	1,500 E	10
DIMETHYLPHENOL, 2,4-	105-67-9	73	32 E	200	87 E	7,300	3,200 E	10,000	8,700 E	10,000	10,000 C	10,000	10,000 C	NA
DINITROBENZENE, 1,3-	99-65-0	0.1	0.049 E	0.1	0.049 E	10	4.9 E	10	4.9 E	100	49 E	100	49 E	NA
DINITROPHENOL, 2,4-	51-28-5	1.9	0.21 E	4.1	0.46 E	190	21 E	410	46 E	19	2.1 E	41	4.6 E	NA
DINITROTOLUENE, 2,4-	121-14-2	0.21	0.05 E	0.84	0.2 E	21	5 E	84	20 E	210	50 E	840	200 E	NA
DINITROTOLUENE, 2,6- (2,6-DNT)	606-20-2	3.7	1.1 E	10	3 E	370	110 E	1,000	300 E	3,700	1,100 E	10,000	3,000 E	NA
DINOSEB	88-85-7	0.7	0.29 E	0.7	0.29 E	70	29 E	70	29 E	70	29 E	70	29 E	NA
DIOXANE, 1,4-	123-91-1	0.56	0.073 E	2.4	0.31 E	56	7.3 E	240	31 E	5.6	0.73 E	24	3.1 E	NA
DIPHENAMID	957-51-7	20	12 E	20	12 E	2,000	1,200 E	2,000	1,200 E	20	12 E	20	12 E	NA
DIPHENYLAMINE	122-39-4	20	12 E	20	12 E	2,000	1,200 E	2,000	1,200 E	20,000	12,000 E	20,000	12,000 E	NA
DIPHENYLHYDRAZINE, 1,2-	122-66-7	0.083	0.15 E	0.33	0.58 E	8.3	15 E	25	44 E	25	44 E	25	44 E	30
DIOQUAT	85-00-7	2	0.24 E	2	0.24 E	200	24 E	200	24 E	2	0.24 E	2	0.24 E	NA
DISULFOTON	298-04-4	0.03	0.078 E	0.03	0.078 E	3	7.8 E	3	7.8 E	3	7.8 E	3	7.8 E	20
DIURON	330-54-1	1	0.86 E	1	0.86 E	100	86 E	100	86 E	1	0.86 E	1	0.86 E	NA
ENDOSULFAN	115-29-7	5.8	30 E	12	61 E	48	250 E	48	250 E	48	250 E	48	250 E	15
ENDOSULFAN I (ALPHA)	959-98-8	22	110 E	50	260 E	50	260 E	50	260 E	22	110 E	50	260 E	15
ENDOSULFAN II (BETA)	33213-65-9	22	130 E	45	260 E	45	260 E	45	260 E	22	130 E	45	260 E	15

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
 B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil Buffer Distance (feet)
		TDS ≤ 2500						TDS > 2500						
		Residential			Non-Residential			Residential			Non-Residential			
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	
ENDOSULFAN SULFATE	1031-07-8	12	70 E	12	70 E	12	70 E	12	70 E	12	70 E	12	70 E	15
ENDOSULFAN	145-73-3	10	4.1 E	10	4.1 E	1,000	410 E	10	410 E	10	4.1 E	10	4.1 E	NA
ENDRIN	72-20-8	0.2	5.5 E	0.2	5.5 E	20	550 E	20	550 E	0.2	5.5 E	0.2	5.5 E	15
EPICHLOROHYDRIN	106-89-8	0.28	0.056 E	0.28	0.12 E	28	5.6 E	58	12 E	28	5.6 E	58	12 E	NA
ETHEPHON	16672-87-0	18	2.1 E	51	5.9 E	1,800	210 E	51	5.9 E	18	2.1 E	51	5.9 E	NA
ETHION	563-12-2	18	39 E	51	110 E	85	1,900 E	85	1,900 E	18	39 E	51	110 E	15
ETHOXYETHANOL, 2- (EGEE)	110-80-5	55	7.8 E	120	17 E	5,500	780 E	10,000	1,700 E	5,500	780 E	10,000	1,700 E	NA
ETHYL ACETATE	141-78-6	870	220 E	1,800	470 E	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	NA
ETHYL ACRYLATE	140-88-5	0.31	0.12 E	1.3	0.5 E	31	12 E	130	50 E	31	12 E	130	50 E	NA
ETHYL BENZENE	100-41-4	70	46 E	70	46 E	7,000	4,600 E	7,000	4,600 E	7,000	4,600 E	7,000	4,600 E	NA
ETHYL DIPROPYLTHIOCARBAMATE, S- (EPTC)	759-94-4	91	65 E	260	180 E	9,100	6,500 E	10,000	10,000 C	91	65 E	260	180 E	NA
ETHYL ETHER	60-29-7	190	53 E	410	120 E	10,000	5,300 E	10,000	10,000 C	190	53 E	410	120 E	NA
ETHYL METHACRYLATE	97-63-2	87	14 E	180	30 E	8,700	1,400 E	18,000	3,000 E	87	14 E	180	30 E	NA
ETHYLENE GLYCOL	107-21-1	1,400	170 E	1,400	170 E	10,000	10,000 E	10,000	10,000 E	10,000	10,000 E	10,000	10,000 E	NA
ETHYLENE THIOUREA (ETU)	96-45-7	0.3	0.034 E	0.3	0.034 E	30	3.4 E	30	3.4 E	300	34 E	300	34 E	NA
ETHYL-NITROPHENYL PHENYLPHOSPHOROTHIOATE	2104-64-5	0.037	0.12 E	0.1	0.31 E	3.7	12 E	10	31 E	0.037	0.12 E	0.1	0.31 E	20
FENAMIPHOS	22224-92-6	0.2	0.17 E	0.2	0.17 E	20	17 E	20	17 E	0.2	0.17 E	0.2	0.17 E	NA
FENVALERATE (PYDRIN)	51630-58-1	8.5	94 E	8.5	94 E	8.5	94 E	8.5	94 E	8.5	94 E	8.5	94 E	15
FLUOMETURON	2164-17-2	9	2.5 E	9	2.5 E	900	250 E	900	250 E	9	2.5 E	9	2.5 E	NA
FLUORANTHENE	206-44-0	26	3,200 E	26	3,200 E	26	3,200 E	26	3,200 E	26	3,200 E	26	3,200 E	10
FLUORENE	86-73-7	150	3,000 E	190	3,800 E	190	3,800 E	190	3,800 E	190	3,800 E	190	3,800 E	15
FLUOROTRICHLOROMETHANE (FREON 11)	75-69-4	200	87 E	200	87 E	10,000	8,700 E	10,000	8,700 E	10,000	8,700 E	10,000	8,700 E	NA
FONOFOS	944-22-0	1	2.9 E	1	2.9 E	100	290 E	100	290 E	1	2.9 E	1	2.9 E	20
FORMALDEHYDE	50-00-0	100	12 E	100	12 E	10,000	1,200 E	10,000	1,200 E	10,000	1,200 E	10,000	1,200 E	NA
FORMIC ACID	64-18-6	1,900	210 E	4,100	460 E	10,000	10,000 C	10,000	10,000 C	10,000	2,100 E	10,000	4,600 E	NA
FOSETYL-AL	39148-24-8	11,000	9,700 E	31,000	27,000 E	190,000	190,000 C	190,000	190,000 C	11,000	9,700 E	31,000	27,000 E	NA

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Non-Use Aquifers				Soil Buffer Distance (feet)
		TDS ≤ 2500						TDS > 2500										
		Residential		Non-Residential		Residential		Non-Residential		Residential		Non-Residential		Residential		Non-Residential		
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	
FURAN	110-00-9	0.97	0.42 E	2	0.87 E	97	42 E	200	87 E	97	42 E	200	87 E	200	87 E	N/A		
FURFURAL	98-01-1	11	1.4 E	29	3.7 E	1,104	140 E	2,900	370 E	11	1.4 E	29	3.7 E	29	3.7 E	N/A		
GLYPHOSATE	1071-83-4	70	620 E	70	620 E	7,000	62,000 E	7,000	62,000 E	70	620 E	70	620 E	70	620 E	15		
HEPTACHLOR	76-44-8	0.04	0.68 E	0.04	0.68 E	4	68 E	4	68 E	4	68 E	18	310 E	18	310 E	15		
HEPTACHLOR EPOXIDE	1024-57-3	0.02	1.1 E	0.02	1.1 E	2	110 E	2	110 E	20	1,100 E	20	1,100 E	20	1,100 E	10		
HEXACHLOROBENZENE	118-74-1	0.1	0.96 E	0.1	0.96 E	0.6	5.8 E	0.6	5.8 E	0.6	5.8 E	0.6	5.8 E	0.6	5.8 E	15		
HEXACHLOROBUTADIENE	87-68-3	0.1	1.2 E	0.1	1.2 E	10	120 E	10	120 E	100	1,200 E	100	1,200 E	100	1,200 E	15		
HEXACHLOROCYCLOPENTADIENE	77-47-4	5	91 E	5	91 E	180	3,300 E	180	3,300 E	180	3,300 E	180	3,300 E	180	3,300 E	15		
HEXACHLOROETHANE	67-72-1	0.1	0.56 E	0.1	0.56 E	10	56 E	10	56 E	10	56 E	10	56 E	10	56 E	15		
HEXANE	110-54-3	55	500 E	120	1,100 E	950	8,700 E	950	8,700 E	55	500 E	55	500 E	50	820 E	15		
HEXYTHIAZOX (SAVEY)	78587-05-0	50	820 E	50	820 E	50	820 E	50	820 E	50	820 E	50	820 E	50	820 E	15		
HYDRAZINE/HYDRAZINE SULFATE	302-01-2	0.00088	0.00098 E	0.0038	0.00042 E	0.088	0.0098 E	0.38	0.042 E	0.0088	0.00098 E	0.038	0.0042 E	0.038	0.0042 E	N/A		
HYDROQUINONE	123-31-9	150	20 E	410	55 E	15,000	2,000 E	41,000	5,500 E	150,000	20,000 E	190,000	55,000 E	190,000	55,000 E	N/A		
INDENOL 2,3-CDPYRENE	193-39-5	0.09	7,000 E	0.36	28,000 E	6.2	190,000 C	6.2	190,000 C	6.2	190,000 C	6.2	190,000 C	6.2	190,000 C	5		
IPRODIONE	36734-19-7	150	430 E	410	1,200 E	1,300	3,700 E	1,300	3,700 E	150	430 E	410	1,200 E	410	1,200 E	20		
ISOBUTYL ALCOHOL	78-83-1	290	76 E	610	160 E	10,000	7,600 E	10,000	7,600 E	10,000	7,600 E	10,000	7,600 E	10,000	7,600 E	N/A		
ISOPHORBONE	78-59-1	10	1.9 E	10	1.9 E	1,000	190 E	1,000	190 E	1,000	190 E	10,000	1,900 E	10,000	1,900 E	N/A		
KEPONE	143-50-0	0.0041	0.56 E	0.016	2.2 E	0.41	56 E	1.6	220 E	4.1	560 E	16	2,200 E	16	2,200 E	10		
MALATHION	121-75-5	10	34 E	10	34 E	1,000	3,400 E	1,000	3,400 E	1,000	3,400 E	1,000	3,400 E	1,000	3,400 E	20		
MALEIC HYDRAZIDE	123-33-1	400	47 E	400	47 E	40,000	4,700 E	40,000	4,700 E	400	47 E	400	47 E	400	47 E	N/A		
MANEB	12427-38-2	18	2 E	51	5.8 E	1,800	200 E	2,300	260 E	18	2 E	51	6 E	51	6 E	N/A		
MERPHOS OXIDE	78-48-8	0.11	15 E	0.31	41 E	11	1,500 E	31	4,100 E	0.11	15 E	0.31	41 E	0.31	41 E	10		
METHACRYLONITRILE	126-98-7	0.19	0.031 E	0.41	0.067 E	19	3.1 E	41	6.7 E	0.19	0.031 E	0.41	0.067 E	0.41	0.067 E	N/A		
METHAMIDOPHOS	10265-92-6	0.18	0.022 E	0.51	0.063 E	18	2.2 E	51	6.3 E	0.18	0.022 E	0.51	0.063 E	0.51	0.063 E	N/A		
METHANOL	67-56-1	490	58 E	1,000	120 E	10,000	5,800 E	10,000	10,000 C	10,000	10,000 C	10,000	5,800 E	10,000	10,000 C	N/A		
METHOMYL	16752-77-5	20	3.2 E	20	3.2 E	2,000	320 E	2,000	320 E	20	3.2 E	20	3.2 E	20	3.2 E	N/A		
METHOXYCHLOR	72-43-5	4	630 E	4	630 E	4	630 E	4	630 E	4	630 E	4	630 E	4	630 E	10		

¹For other options see § 250.308

All concentrations are in mg/kg.
 E - Number calculated by the soil to groundwater equation in § 250.308
 C - Cap
 NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers														Soil
		TDS ≤ 2500														
		TDS > 2500							Non-Use Aquifers							
		Residential 100 X GW MSC	Non-Residential 100 X GW MSC	Generic Value	Residential 100 X GW MSC	Non-Residential 100 X GW MSC	Generic Value	Residential 100 X GW MSC	Non-Residential 100 X GW MSC	Generic Value	Residential 100 X GW MSC	Non-Residential 100 X GW MSC	Generic Value	Residential 100 X GW MSC	Non-Residential 100 X GW MSC	
METHOXYETHANOL, 2-	109-86-4	3.7	0.41 E	10	1.1 E	370	41 E	1,000	110 E	3.7	0.41 E	10	1.1 E	NA		
METHYL ACETATE	79-20-9	3700	690 E	10,000	1,900 E	10,000	10,000 C	10,000	10,000 C	3,700	690 E	10,000	1,900 E	NA		
METHYL ACRYLATE	96-33-3	110	27 E	310	77 E	10,000	2,700 E	10,000	7,700 E	10,000	2700 E	10,000	7,700 E	NA		
METHYL CHLORIDE	74-87-3	0.3	0.038 E	0.3	0.038 E	30	3.8 E	30	3.8 E	30	3.8 E	30	3.8 E	NA		
METHYL ETHYL KETONE	78-93-3	280	54 E	580	110 E	10,000	5,400 E	10,000	10,000 C	10,000	5,400 E	10,000	10,000 C	NA		
METHYL ISOBUTYL KETONE	108-10-1	19	2.9 E	41	6.3 E	1,900	290 E	4,100	630 E	1,900	290 E	4,100	630 E	NA		
METHYL METHACRYLATE	80-62-6	190	26 E	410	56 E	10,000	2,600 E	10,000	5,600 E	10,000	2,600 E	10,000	5,600 E	NA		
METHYL METHANESULFONATE	66-27-3	0.67	0.083 E	2.6	0.32 E	67	8.3 E	260	32 E	0.67	0.083 E	2.6	0.32 E	NA		
METHYL PARATHION	298-00-0	0.2	0.42 E	0.2	0.42 E	20	42 E	20	42 E	20	42 E	20	42 E	30		
METHYL STYRENE (MIXED ISOMERS)	25013-15-4	22	120 E	61	340 E	2,200	12,000 E	6,100	34,000 E	22	120 E	61	340 E	15		
METHYL TERT-BUTYL ETHER (MTBE)	1634-04-4	2	0.28 E	2	0.28 E	200	28 E	200	28 E	20	2.8 E	20	2.8 E	NA		
METHYLENE BIS(2-CHLOROANILINE), 4,4'-	101-14-4	0.51	3.9 E	2	15 E	51	390 E	200	1,500 E	0.51	3.9 E	2	15 E	15		
METHYLNAPHTHALENE, 2-	91-57-6	73	2,900 E	200	8,000 E	2,500	10,000 C	2,500	10,000 C	73	2,900 E	200	8,000 E	15		
METHYLNAPHTHALENE, ALPHA	98-83-9	68	120 E	140	250 E	6,800	12,000 E	14,000	25,000 E	68	120 E	140	250 E	30		
NAPHTHALENE	91-20-3	10	25 E	10	25 E	1,000	2,500 E	1,000	2,500 E	3,000	7,500 E	3,000	7,500 E	30		
NAPHTHYLAMINE, 1-	134-32-7	0.037	0.3 E	0.14	1.1 E	3.7	30 E	14	110 E	37	300 E	140	1,100 E	15		
NAPHTHYLAMINE, 2-	91-59-8	0.037	0.012 E	0.14	0.046 E	3.7	12 E	14	4.6 E	37	12 E	140	46 E	NA		
NAPROPAMIDE	15299-99-7	370	860 E	1,000	2,300 E	7,000	16,000 E	7,000	16,000 E	370	860 E	1,000	2,300 E	30		
NITROANILINE, M-	99-09-2	0.21	0.033 E	0.58	0.091 E	21	3.3 E	58	9.1 E	0.21	0.033 E	0.58	0.091 E	NA		
NITROANILINE, O-	88-74-4	0.21	0.038 E	0.58	0.1 E	21	3.8 E	58	10 E	0.21	0.038 E	0.58	0.1 E	NA		
NITROANILINE, P-	100-01-4	0.21	0.031 E	0.58	0.086 E	21	3.1 E	58	8.6 E	0.21	0.031 E	0.58	0.086 E	NA		
NITROBENZENE	98-95-3	1.8	0.79 E	5.1	2.2 E	180	79 E	510	220 E	1,800	790 E	5,100	2,200 E	NA		
NITROPHENOL, 2-	88-75-5	29	5.9 E	82	17 E	2,900	590 E	8,200	1,700 E	29,000	5,900 E	8,200	17,000 E	NA		
NITROPHENOL, 4-	100-02-7	6	4.1 E	6	4.1 E	600	410 E	600	410 E	6,000	4,100 E	6,000	4,100 E	NA		
NITROPROPANE, 2-	79-46-9	0.0016	0.00026 E	0.0068	0.0011 E	0.16	0.026 E	0.68	0.11 E	0.016	0.0026 E	0.068	0.011 E	NA		
NITROSODIETHYLAMINE, N-	55-18-5	0.0001	0.000018 E	0.00043	0.000076 E	0.01	0.0018 E	0.043	0.0076 E	0.001	0.00018 E	0.0043	0.00076 E	NA		

¹For other options see § 250.308
 All numbers are in mg/kg
 E - Number calculated by the soil to groundwater equation in § 250.308
 C - Cap
 NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers																Soil	Buffer Distance (feet)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
		TDS ≤ 2500						TDS > 2500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
		Residential			Non-Residential			Residential			Non-Residential			Residential			Non-Residential																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
		100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X GW MSC Value																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
NITROSODIMETHYLAMINE, N-	62-75-9	0.00031	0.000041	0.0013	0.00017	E	0.031	0.0041	E	0.13	0.017	E	0.031	0.00041	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.013	0.0017	E	0.0

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
 B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers										Non-Use Aquifers				Soil Buffer Distance (feet)
		TDS ≤ 2500					TDS > 2500									
		Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Generic Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Generic Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Generic Value	Residential 100 X GW MSC Value	Non-Residential 100 X GW MSC Value	Generic Value			
PICLORAM	1918-02-1	50	7.4 E	50	7.4 E	5,000	740 E	50	7.4 E	50	7.4 E	50	7.4 E	50	7.4 E	NA
PROXAMIDE	23950-58-5	5	3.1 E	5	3.1 E	500	310 E	500	2,600 E	5	3.1 E	5	3.1 E	5	3.1 E	NA
PROXANIL	709-98-8	18	9.2 E	51	26 E	1,800	920 E	5,100	2,600 E	18	9 E	51	26 E	18	9 E	NA
PROPHAM	122-42-9	73	17 E	200	48 E	7,300	1,700 E	20,000	4,800 E	73	17 E	200	48 E	73	17 E	NA
PROPYLBENZENE, N-	101-65-1	150	290 E	410	780 E	5,200	9,900 E	5,200	9,900 E	150	290 E	410	780 E	150	290 E	30
PROPYLENE OXIDE	75-56-9	0.28	0.049 E	1.1	0.19 E	28	4.9 E	110	19 E	0.28	0.049 E	1.1	0.19 E	0.28	0.049 E	NA
PYRENE	129-00-0	13	2,200 E	13	2,200 E	13	2,200 E	13	2,200 E	13	2,200 E	13	2,200 E	13	2,200 E	10
PYRIDINE	110-86-1	0.97	0.11 E	2	0.22 E	97	11 E	200	22 E	97	1.1 E	20	2.2 E	97	1.1 E	NA
QUINOLINE	91-22-5	0.0055	0.018 E	0.022	0.074 E	0.55	1.8 E	2.2	7.4 E	0.55	1.8 E	2.2	7.4 E	0.55	1.8 E	20
QUINALOOP (ASSURE)	76578-14-8	30	47 E	30	47 E	30	47 E	30	47 E	30	47 E	30	47 E	30	47 E	30
RONNEL	299-84-3	180	280 E	510	800 E	4,000	6,200 E	4,000	6,200 E	180	280 E	510	800 E	180	280 E	30
SIMAZINE	122-34-9	0.4	0.15 E	0.4	0.15 E	40	15 E	40	15 E	0.4	0.15 E	40	15 E	0.4	0.15 E	NA
STRYCHNINE	57-24-9	1.1	0.89 E	3.1	2.5 E	110	89 E	310	250 E	1.1	0.89 E	310	250 E	1.1	0.89 E	NA
STYRENE	100-42-5	10	24 E	10	24 E	1,000	2,400 E	1,000	2,400 E	10	24 E	1,000	2,400 E	1,000	2,400 E	30
TETRATHIURON	34014-18-1	50	83 E	50	83 E	5,000	8,300 E	5,000	8,300 E	50	83 E	5,000	8,300 E	50	83 E	30
TERBACIL	5902-51-2	9	2.2 E	9	2.2 E	900	220 E	900	220 E	9	2.2 E	9	2.2 E	9	2.2 E	NA
TERBUFOS	13071-79-9	0.09	0.12 E	0.09	0.12 E	9	12 E	9	12 E	0.09	0.12 E	0.09	0.12 E	0.09	0.12 E	30
TETRACHLOROBENZENE, 1,2,4,5-	95-94-3	1.1	5.1 E	3.1	14 E	58	270 E	58	270 E	58	270 E	58	270 E	58	270 E	20
TETRACHLORODIBENZO-P-DIOXIN, 2,3,7,8-(TCDD)	1746-01-6	0.000003	0.032 E	0.000003	0.032 E	0.0003	3.2 E	0.0003	3.2 E	0.0003	3.2 E	0.0003	3.2 E	0.0003	3.2 E	5
TETRACHLOROETHANE, 1,1,1,2-	630-20-6	7	18 E	7	18 E	700	1,800 E	700	1,800 E	700	1,800 E	700	1,800 E	700	1,800 E	30
TETRACHLOROETHANE, 1,1,2,2-	79-34-5	0.03	0.093 E	0.03	0.093 E	3	0.93 E	3	0.93 E	3	0.93 E	3	0.93 E	3	0.93 E	NA
TETRACHLOROETHYLENE (PCE)	127-18-4	0.3	0.43 E	0.3	0.43 E	30	43 E	30	43 E	30	43 E	30	43 E	30	43 E	NA
TETRACHLOROPHENOL, 2,3,4,6-	58-90-2	29	450 E	61	950 E	2,900	45,000 E	6,100	95,000 E	2,900	45,000 E	6,100	95,000 E	2,900	45,000 E	15
TETRAETHYL LEAD	78-00-2	0.00037	0.0046 E	0.001	0.012 E	0.037	0.46 E	0.1	1.2 E	0.037	0.46 E	0.1	1.2 E	0.037	0.46 E	15
TETRAETHYL DITHIOPYROPHOSPHATE	3689-24-5	0.49	0.73 E	1	1.5 E	49	73 E	100	150 E	0.49	0.73 E	1	1.5 E	0.49	0.73 E	30
THIOFANOX	39196-18-4	1.1	0.12 E	3.1	0.34 E	110	12 E	310	34 E	1.1	0.12 E	3.1	0.34 E	1.1	0.12 E	NA

¹ For other options see § 250.308.

All concentrations in mg/kg.

E - Number calculated by the soil to groundwater equation in § 250.308.

C - Cap.

NA - The soil buffer distance option is not available for this substance.

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers										Non-Use Aquifers				Soil Buffer Distance (feet)	
		TDS ≤ 2500					TDS > 2500					Residential		Non-Residential			
		100 X GW MSC		Generic Value	100 X GW MSC		Generic Value	100 X GW MSC		Generic Value	100 X GW MSC		Generic Value	100 X GW MSC			Generic Value
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value		
THIRAM	137-26-8	18	47 E	51	130 E	1,800	4,700 E	3,000	7,800 E	18	47 E	51	130 E	20			
TOLUENE	108-88-3	104	44 E	104	44 E	10,000	4,400 E	10,000	4,400 E	10,000	4,400 E	10,000	4,400 E	NA			
TOLUIDINE, M-	108-44-1	0.28	0.13 E	1.1	0.51 E	28	13 E	110	51 E	0.28	0.13 E	1.1	0.51 E	NA			
TOLUIDINE, O-	95-53-4	0.28	0.32 E	1.1	1.2 E	28	32 E	110	120 E	280	320 E	1.1	1,700 E	NA			
TOLUIDINE, P-	106-49-6	0.35	0.32 E	1.4	1.3 E	35	32 E	140	130 E	0.35	0.32 E	1.4	1.3 E	NA			
TOXAPHENE	8001-35-2	0.3	1.2 E	0.3	1.2 E	30	120 E	30	120 E	0.3	1.2 E	0.3	1.2 E	20			
TRIALLATE	2303-17-5	47	240 E	130	660 E	400	2,000 E	400	2,000 E	47	240 E	130	660 E	15			
TRIBROMOMETHANE (BROMOFORM)	75-25-2	10	4.4 E	10	4.4 E	1,000	440 E	1,000	440 E	1,000	440 E	1,000	440 E	NA			
TRICHLORO-1,2,2-TRIFLUOROETHANE, 1,1,2-	76-13-1	8,300	26,000 E	17,000	53,000 E	17,000	53,000 E	17,000	53,000 E	17,000	53,000 E	17,000	53,000 E	20			
TRICHLOROETHANE, 1,2,4-	120-82-1	7	27 E	7	27 E	700	2,700 E	700	2,700 E	4,400	10,000 C	4,400	10,000 C	15			
TRICHLOROBENZENE, 1,3,5-	108-70-3	4	31 E	4	31 E	400	3,100 E	400	3,100 E	4	31 E	4	31 E	20			
TRICHLOROETHANE, 1,1,1-	71-55-6	20	7.2 E	20	7.2 E	2,000	720 E	2,000	720 E	200	72 E	200	72 E	NA			
TRICHLOROETHANE, 1,1,2-	79-00-5	0.5	0.15 E	0.5	0.15 E	50	15 E	50	15 E	5	1.5 E	5	1.5 E	NA			
TRICHLOROETHYLENE (TCE)	79-01-6	0.5	0.17 E	0.5	0.17 E	50	17 E	50	17 E	5	1.7 E	5	1.7 E	NA			
TRICHLOROPHENOL, 2,4,5-	95-93-4	370	2,300 E	1,000	6,100 E	37,000	190,000 C	100,000	190,000 C	100,000	190,000 C	100,000	190,000 C	15			
TRICHLOROPHENOL, 2,4,6-	88-06-2	1.1	3.1 E	3.1	8.9 E	110	310 E	310	890 E	1,100	3,100 E	3,100	8,900 E	20			
TRICHLOROPHENOXYACETIC ACID, 2,4,5- (2,4,5-T)	93-76-5	7	1.5 E	7	1.5 E	700	150 E	700	150 E	7,000	1,500 E	7,000	1,500 E	NA			
TRICHLOROPHENOXYPROPIONIC ACID, 2,4,5- (2,4,5-TPSILVEX)	93-72-1	5	22 E	5	22 E	500	2,200 E	500	2,200 E	5	22 E	5	22 E	20			
TRICHLOROPROPANE, 1,1,2-	598-77-6	18	3.1 E	51	8.7 E	1,800	310 E	1,800	310 E	18	3.1 E	51	8.7 E	NA			
TRICHLOROPROPANE, 1,2,3-	96-18-4	4	3.2 E	4	3.2 E	400	320 E	400	320 E	400	320 E	400	320 E	NA			
TRICHLOROPROPENE, 1,2,3-	96-19-5	18	11 E	51	30 E	1,800	1,100 E	1,800	1,100 E	18	11 E	51	30 E	NA			
TRIFLURALIN	1582-09-8	0.5	0.96 E	0.5	0.96 E	50	96 E	50	96 E	0.5	0.96 E	0.5	0.96 E	30			
TRIMETHYLBENZENE, 1,3,4- (TRIMETHYLBENZENE, 1,2,4-)	95-63-6	1.6	9 E	3.5	20 E	160	900 E	160	900 E	160	900 E	350	2,000 E	15			
TRIMETHYLBENZENE, 1,3,5-	108-67-8	1.6	2.8 E	3.5	6.2 E	160	280 E	160	280 E	1.6	2.8 E	3.5	6.2 E	30			

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

TABLE 3—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR ORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil
		TDS ≤ 2500						TDS > 2500						
		Residential			Non-Residential			Residential			Non-Residential			
		100 X GW MSC Value	Generic Value	100 X GW MSC Value	100 X Generic Value	100 X GW MSC Value	100 X Generic Value	100 X GW MSC Value	100 X Generic Value	100 X GW MSC Value	100 X Generic Value	100 X GW MSC Value	100 X Generic Value	
TRINITROTOLUENE, 2,4,6-	118-96-7	0.2	0.023 E	0.2	0.023 E	20	2.3 E	20	2.3 E	0.2	0.023 E	0.2	0.023 E	NA
VINYLACETATE	108-05-4	55	6.5 E	120	14 E	5,500	650 E	10,000	1,400 E	55	6.5 E	120	14 E	NA
VINYL BROMIDE (BROMOETHENE)	593-60-2	0.14	0.068 E	0.58	0.28 E	14	6.8 E	58	28 E	14	6.8 E	58	28 E	NA
VINYL CHLORIDE	75-01-4	0.2	0.027 E	0.2	0.027 E	20	2.7 E	20	2.7 E	2	0.27 E	2	0.27 E	NA
WARFARIN	81-81-2	1.1	2.6 E	3.1	7.4 E	110	260 E	310	740	1,100	2,600	1,700	4,100	30
XYLENES (TOTAL)	1330-20-7	1,000	990 E	1,000	990 E	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	10,000	10,000 C	NA
ZINEB	12122-67-7	180	29 E	510	81 E	1,000	160 E	1,000	160 E	180	29 E	510	81 E	NA

¹For other options see § 250.308

All concentrations in mg/kg

E - Number calculated by the soil to groundwater equation in § 250.308

C - Cap

NA - The soil buffer distance option is not available for this substance

APPENDIX A

TABLE 4—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR
INORGANIC REGULATED SUBSTANCES IN SOIL

A. Direct Contract Numeric Values

REGULATED SUBSTANCE	CASRN	Residential	Non-Residential MSCs	
		MSC 0-15 feet	Surface Soil 0-2 feet	Subsurface Soil 2-15 feet
ALUMINUM	7429-90-5	190,000 C	190,000 C	190,000 C
ANTIMONY	7440-36-0	88 G	1,100 G	190,000 C
ARSENIC	7440-38-2	12 G	53 G	190,000 C
BARIUM AND COMPOUNDS	7440-39-3	15,000 G	190,000 C	190,000 C
BERYLLIUM	7440-41-7	440 G	5,600 G	190,000 C
BORON AND COMPOUNDS	7440-42-8	20,000 G	190,000 C	190,000 C
CADMIUM	7440-43-9	47 G	210 G	190,000 C
CHROMIUM III	16065-83-1	190,000 C	190,000 C	190,000 C
CHROMIUM VI	18540-29-9	94 G	420 G	190,000 C
COBALT	7440-48-4	4,400 G	56,000 G	190,000 C
COPPER	7440-50-8	8,200 G	100,000 G	190,000 C
CYANIDE, FREE	57-12-5	4,400 G	56,000 G	190,000 C
IRON	7439-89-6	66,000 G	190,000 C	190,000 C
LEAD	7439-92-1	500 U	1,000 S	190,000 C
MANGANESE	7439-96-5	31,000 G	190,000 G	190,000 C
MERCURY	7439-97-6	66 G	840 G	190,000 C
NICKEL	7440-02-0	4,400 G	56,000 G	190,000 C
SELENIUM	7782-49-2	1,100 G	14,000 G	190,000 C
SILVER	7440-22-4	1,100 G	14,000 G	190,000 C
THALLIUM	7440-28-0	15 G	200 G	190,000 C
TIN	7440-31-5	130,000 G	190,000 C	190,000 C
VANADIUM	7440-62-2	1,500 G	20,000 G	190,000 C

250-137

(285871) No. 327 Feb. 02

REGULATED SUBSTANCE	CASRN	Residential	Non-Residential MSCs	
		MSC	Surface	Subsurface
		0-15 feet	Soil 0-2 feet	Soil 2-15 feet
ZINC	7440-66-6	66,000 G	190,000 C	190,000 C

All concentrations in mg/kg [except asbestos, which is in fibers/kg]

R - Residential

NR - Non-Residential

G - Ingestion

H - Inhalation

C - Cap

U - UBK Model

S - SEGH Model

NA - Not Applicable

APPENDIX
TABLE 4—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR INORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹

REGULATED SUBSTANCE	CASRN	Used Aquifers												Soil Buffer Distance (feet)		
		TDS ≤ 2500						TDS > 2500								
		R		N		Generic Value		R		N		Generic Value				
		100 X GW MSC		100 X GW MSC		Generic Value		100 X GW MSC		Generic Value		100 X GW MSC			Generic Value	
ALUMINUM																
ANTIMONY																
ARSENIC																
BARIUM AND COMPOUNDS																
BERYLLIUM																
BORON AND COMPOUNDS																
CADMIUM																
CHROMIUM III																
CHROMIUM VI																
COBALT																

¹For other options see Section 250.308

All concentrations in mg/kg

R - Residential
 NR - Non-Residential
 G - Ingestion
 H - Inhalation
 C - Cap
 U - UBK Model
 S - SEGH Model
 NA - Not Applicable

TABLE 4—MEDIUM-SPECIFIC CONCENTRATIONS (MSCs) FOR INORGANIC REGULATED SUBSTANCES IN SOIL
B. Soil to Groundwater Numeric Values¹—(Continued)

REGULATED SUBSTANCE	CASRN	Used Aquifers																Soil Buffer Distance (feet)	
		TDS ≤ 2500						TDS > 2500											
		100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	N	R	100 X GW MSC	Generic Value	100 X GW MSC	Generic Value	N	R	100 X GW MSC	Generic Value	N			
COPPER		7440-50-8	100	36,000	100	36,000	100	36,000	10,000	190,000	10,000	190,000	10,000	190,000	100,000	190,000	100,000	190,000	10
CYANIDE, FREE		57-12-5	20	200	20	200	200	200	2,000	20,000	2,000	20,000	2,000	20,000	20,000	190,000	20,000	190,000	20
IRON		7439-89-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	N/A
LEAD		7439-02-1	0.5	450	0.5	450	450	50	45,000	50	45,000	50	45,000	500	190,000	500	190,000	10	
MANGANESE		7439-96-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	N/A
MERCURY		7439-97-6	0.2	10	0.2	10	10	20	1,000	20	1,000	20	1,000	200	10,000	200	10,000	15	
NICKEL		7440-02-0	10	650	10	650	650	1,000	65,000	1,000	65,000	1,000	65,000	10,000	190,000	10,000	190,000	15	
SELENIUM		7782-49-2	5	26	5	26	26	500	2,600	500	2,600	500	2,600	5,000	26,000	5,000	26,000	20	
SILVER		7440-22-4	10	84	10	84	84	1,000	8,400	1,000	8,400	1,000	8,400	10,000	84,000	10,000	84,000	20	
THALLIUM		7440-28-0	0.2	14	0.20	14	14	20	1,400	20	1,400	20	1,400	200	14,000	200	14,000	15	
TIN		7440-31-5	2,200	240	6,100	680	680	190,000	24,000	190,000	24,000	190,000	68,000	190,000	190,000	190,000	190,000	N/A	
VANADIUM		7440-62-2	26	26,000	72	72,000	72,000	2,600	190,000	7,200	190,000	7,200	190,000	26,000	190,000	72,000	190,000	5	
ZINC		7440-66-6	200	12,000	200	12,000	12,000	20,000	190,000	20,000	190,000	20,000	190,000	190,000	190,000	190,000	190,000	15	

¹ For other options see Section 250.308
 C - Cap
 U - UBK Model
 S - SEGH Model
 All concentrations in mg/kg
 R - Residential
 NR - Non-Residential
 G - Ingestion
 H - Inhalation
 NA - Not Applicable

APPENDIX E

SITE-SPECIFIC HEALTH AND SAFETY PLAN

**HEALTH AND SAFETY PLAN
FOR
PHASE II ENVIRONMENTAL SITE ASSESSMENT ACTIVITIES**

Brownfields Pilot Project
Mifflin County Planning and Development Department
20 North Wayne Street
Lewistown, PA 17044

Prepared for:

ARM Personnel

March 2003

ARM Project 02242



ARM Group Inc.

Earth Resource Engineers and Consultants

1129 W. Governor Road, P.O. Box 797 • Hershey, PA 17033-0797

Voice: (717) 533-8600 Fax: (717) 533-8605

E-mail: info@armgroup.net

1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared to address personnel health and safety requirements for employees of ARM Group Inc. (ARM) while working at the Mifflin County Planning and Development Department Brownfields Pilot Program sites, (currently the Plaza Site, the Recreation Site, and the Corkins Site). The work includes the completion of Phase II Environmental Site Assessment (ESA) activities that are anticipated to include the collection of soil samples, sediment samples, and groundwater samples. A detailed discussion of the work scope is presented in the site-specific sampling and analyses plans (SAPs).

Mifflin County Planning and Development Department has been awarded a United States Environmental Protection Agency – Region III (USEPA) grant to identify, assess, characterize, and remediate sites in Mifflin County that are currently abandoned or under-utilized, and that have potential for beneficial reuse. The grant was awarded through the USEPA's Brownfields Pilot Project and is intended to focus on sites that may have or may be perceived as having environmental liabilities that hinder their redevelopment. Mifflin County received the Brownfields grant in 2000 and had initially identified over 30 sites for potential redevelopment. USEPA has approved further evaluation and potential remedial response for three sites, as indicated below:

1. A facility previously operated by FMC Corporation/American VISCOS Company for the production of rayon. The site is located in the Mifflin County Industrial Development Corporation (MCIDC) Plaza, 6395 State Route 103 North, Lewistown, Pennsylvania and is owned by MCIDC.
2. A property previously operated by FMC Corporation/American VISCOS Company for the treatment of wastewater generated during the production of rayon. The site was developed with four settling basins and four lagoons. The property is owned by MCIDC and is situated immediately north of the Granville Township Junction Wastewater Treatment Plant. It is anticipated that this site will be redeveloped for recreational uses and is referred to as the Recreation Site.
3. The Corkins Site has been used for the restoration of antique automobiles since approximately 1982 and was used for various commercial purposes prior to that time. The Corkins Site is located at 233 East Third Street, Lewistown, Pennsylvania, an area of Lewistown considered esthetically important to downtown revitalization. The property is currently owned by Max E. Corkin, Jr. and houses two contiguous buildings and a lean-to structure.

The following sections provide personnel health and safety information and requirements for ARM, its subcontractors and any lower tier subcontractors for activities associated with the completion of the Phase II ESA activities.

Each subcontractor shall be required to have their own HASP that provides an equivalent or greater level of protection than this HASP, or alternatively, the subcontractor may adopt for their own use this HASP. ARM shall not be responsible for the health and safety of any subcontracted employees.

2.0 SITE DESCRIPTION

The following is a summary of the site and related hazards. Chemical hazards are presented in more detail in Section 6.0.

Facility Name: Mifflin County Planning and Development Department
Brownfields Pilot Project Sites
Location: Various locations in and around the City of Lewistown, Mifflin County, Pennsylvania

General Description of Hazards:

Chemical Hazards -

- Detailed in Section 6.0 (Chemical Hazard Inventory)

Physical Hazards -

- Buried utilities
- Slipping/tripping in work area
- Heat stress
- Drilling/excavating equipment

Biological Hazards -

- Plants (i.e., poison ivy, poison oak, poison sumac)
- Insects (i.e., ticks, bees, wasps, spiders)
- Animals (i.e., snakes, rodents)

Mechanical/electrical Hazards -

- Noise from heavy equipment operations (Geoprobe, Hollow Stem Auger Rig)
- Inhalation from dust generated by Geoprobe and Hollow Stem Auger activities

3.0 WORK OBJECTIVES

3.1 Plaza Site

The scope of ARM's Phase II assessment of the Plaza site is based on the results from the Gannett Flemming Phase I, Gannett Flemming's proposed Phase II SAP, and EPA's review comments of the Gannett Flemming SAP of December 2001.

The areas of the site that will be assessed include a wastewater subsidence basin at Building 7, rubble fill materials and soil east of Building 33 and surrounding areas;

stained soil next to a transformer pad at Building 4; and soil beneath the water tower. In addition, because of the historic use of significant quantities of hazardous/regulated materials at the site, and the resultant possibility of on-site spills or disposal of such materials, some subsurface investigation of the unpaved Plaza exterior areas will be performed. These areas will be selected during a pre-investigation site visit, the purpose of which will be to familiarize sampling personnel with the site features, including the health and safety issues. The selected sampling locations will be biased to areas of staining or suspected contamination.

The subsidence basin sediment at Buildings 7 will be sampled with a bucket auger unless precluded by site conditions. If an aqueous phase is present at the subsidence basin, a water sample will also be collected. Samples from the subsidence basin and filter beds will be analyzed for Priority Pollutant List (PPL) Metals, SVOCs, PCBs, VOCs, pesticides and cyanide.

The rubble fill and underlying soil east of Building 33, and the unpaved exterior areas selected for investigation, will be evaluated by hand excavation using a shovel and bucket auger. One composite soil sample from beneath the rubble will be prepared from a minimum of six grab samples collected from the fill area and analyzed for Metals, SVOCs, PCBs, VOCs and cyanides. Hand tools or a backhoe will be used, depending on conditions encountered, to evaluate the unpaved exterior areas selected for investigation. A total of four subsurface soil samples will be collected from exterior areas and will be analyzed for PPL Metals, SVOCs, PCBs, VOCs and cyanide.

The soil samples collected from the water tower and Building 4 transformer pad will be collected with hand tools. Two surficial samples and two deeper samples from the water tower area will be analyzed for total lead. One surficial and one deeper sample from the stained soils next to the transformer pad will be analyzed for PCBs.

The following laboratory methods will be used:

- PCBs for soil, sediment, and water samples - USEPA Method 8082
- Priority Pollutant Metals for soil or water - USEPA Methods 200.7/245.1 or 6010B/7471A
- Priority Pollutant Semi-Volatile Organic Compounds (SVOCs) for soil, sediment or water - USEPA Method 625 or 8270C
- Priority Pollutant Volatile Organic Compounds (VOCs) for soil, sediment or water - USEPA Method 624 or 8260B
- Cyanides for soil, sediment or water - USEPA Method 335.2/9012
- Priority Pollutant Pesticides for soil, sediment or water - USEPA Method 8081A
- Lead for soil - USEPA Method 6010

For mass spectral analysis, the laboratory will include a Tentatively Identified Compound (TIC) list.

3.2 Recreation Site

The Phase II assessment at the Recreation Site will include the assessment of the entire site, consisting of the four settling basins and the four large lagoons. The presence or absence of hazardous materials in the basins and lagoons and in the subsurface at this site will be determined.

Samples of solid materials in the basins and other site features were collected and analyzed during previous investigations at the Recreation Site. Elevated concentrations of several metals and some organics were detected in these materials. Sampling and analyses completed by MCIDC on the sludge existing in the four settling basins at this site confirmed the presence of some metals in the basin sludge.

The main tasks of the Phase II ESA work scope proposed for the Recreation Site are as follows:

- Sampling of sludge/sediment in four lagoons for full PPL suite (one composite sample from each lagoon);
- Sampling of surface water in each lagoon for full Priority Pollutant suite (one sample from each lagoon, if water is present);
- Installation of three groundwater monitoring wells in vicinity of the settling basins and lagoons;
- Collection of groundwater samples from three monitoring wells and analysis for PPL VOCs, Semi-VOCs, and metals; and
- Collection of quality assurance/quality control samples from various media.

The full Priority Pollutant suite includes VOCs, SVOCs, Pesticides/PCBs, and metals. ARM will collect and handle the various environmental samples according to USEPA and PADEP protocols and procedures to produce valid and defensible data. ARM will use specialized subcontractors to assist with the installation of monitoring wells, surveying, and laboratory analyses.

The sludge and sediment samples from the lagoons will be collected with hand-held sampling equipment such as a hand auger or sediment sampler. The surface water samples will be acquired using dedicated plastic bailers. The planned monitoring wells will be drilled using percussion air rotary methods. The three monitoring wells will be constructed of 2-inch diameter PVC well screen and casing. The wells are planned to be approximately 20 to 25 feet deep and will penetrate at least ten feet of the groundwater zone near the basins. Groundwater samples will be collected from the wells using low-flow pumps and/or dedicated bailers. All sampling methods used will comply with USEPA and PADEP standards. The collected chemical data will undergo a data validation process according to USEPA requirements.

3.3 Corkins Site

The proposed Phase II work at the Corkins site includes the collection and analyses of three soil samples from two different locations at the site. Specifically, the Phase II work at the Corkins site will comprise the collection of one soil sample from the drum storage area and two soil samples from separate stained soil areas. The soil sample from the drum area will be analyzed for PPL VOCs and SVOCs. One soil sample from the stained areas will be analyzed for PPL VOCs and metals, while the other sample will be analyzed for PPL VOCs, SVOCs and Metals.

4.0 ON-SITE ORGANIZATION

Compliance with this HASP is required of all workers who are involved with the Phase II ESA activities at the site. All such activities shall be performed under the guidance of the Site Health and Safety Officer (SHSO). The SHSO will implement levels of personal protection required as defined in Section 8 (Personal Protective Equipment), ensure that established safety guidelines are implemented, and record all information relevant to the project (including, but not limited to, analytical data, worker exposure, and personal protective equipment in use).

Table 1 identifies project personnel designated to carry out the stated job functions on-site (Note: one person may carry out more than one job function).

Table 1 Project Organization		
Project Manager	Steve Fulton, ARM Group Inc.	(717) 533-8600 (717) 571-8777 (Cell)
Site Health and Safety Officer	Mark J. Heisey, ARM Group Inc.	(717) 533-8600 (717) 579-4556 (Cell)
Field Team Members	Damian Zampogna, ARM Group Inc. Amy Dominoski, ARM Group Inc.	(717) 533-8600 (717) 979-5858 (Cell)

5.0 GENERAL WORK RULES

All site workers that are involved in activities associated with the Phase II ESA activities should abide by the following rules:

1. Site workers are required to have received 40 hours of safety training and an annual 8-hour refresher under the requirements of OSHA 29 CFR 1910.120.
2. Eating, drinking, chewing gum or tobacco, smoking, or any other practice that increases the probability of hand-to-mouth transfer and ingestion of hazardous materials are prohibited during all activities.

3. Hands and face must be washed following all activities, and before eating, drinking, or other similar activity.
4. In the event that Level C respiratory protection is required, excessive facial hair that interferes with the satisfactory adjustment of the respirator must be removed, and appropriate prescription lenses shall be worn with the respirator.
5. All personnel are required to read and comply with the provisions of this HASP prior to the commencement of any intrusive activities.

This HASP shall be modified as appropriate during the course of the work to ensure that adequate worker protection is provided.

6.0 CHEMICAL HAZARD INVENTORY

Based on previous activities, the substances listed in Table 2 have been identified at the site, or are considered to potentially be present at the site.

Table 2 Chemical Hazard Inventory
Metals: (i.e. Lead, Chromium, Copper, Selenium, Cadmium, etc.)
Volatile Organic Compounds (VOCs): (i.e. BTEX, Cumene, Naphthalene, TCE, PCE, etc.)
Semivolatile Organic Compounds (SVOCs): (i.e. Fluorene, Pyrene, Phenethrene, etc.)
Polychlorinated Biphenyls (PCBs):

7.0 PERSONAL PROTECTIVE EQUIPMENT

The following sections provide pre-established personal protective equipment requirements for task-specific items that will be performed during the Phase II ESA activities.

All activities conducted during the Phase II ESA activities will be completed under Level D respiratory and dermal protection. Efforts shall be made to minimize dust during sampling activities, but should dust generation become problematic, a dust limit will be established and implemented, and the SHSO should upgrade the level of respiratory protection to modified Level C. During sampling activities, an organic vapor analyzer (OVA) will be used to monitor the breathing zone for VOCs. If sustained responses of greater than 10 ppm in the breathing zone are encountered during investigation or sampling activities, the SHSO will upgrade the level of respiratory protection to modified Level C, or evacuate the area until levels have subsided to below the action level. The

Project Manager and SHSO will decide the appropriate cartridges to use should additional levels of respiratory protection be required.

7.1 Minimum PPE

The following PPE should be available at all times:

1. Light coveralls or long pants with work shirt
2. Steel shank and toe safety boots
3. Hard hats
4. Safety glasses
5. Chemical resistant gloves
6. Hearing protection

7.2 Additional PPE

Should the SHSO determine the need for additional PPE, such as Level C respiratory protection and dermal protection, at a minimum the following will be required:

1. Tyvek suit (upgradeable to Saranex)
2. Respirator equipped with Organic Vapor / Acid Gas / P100 cartridges
3. Face shield

Only individuals that have been medically cleared to wear a respiratory and that have been fit tested are permitted to use a respirator.

8.0 HEAT STRESS CONTROL

The following describes the procedures for heat stress monitoring of personnel engaged in the Phase II ESA activities. These procedures apply to all personnel who perform fieldwork in hot weather and who are at risk of developing heat stress.

Heat-induced physiological stress (heat stress) occurs when the body fails to maintain a normal body temperature. A number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

8.1 Monitoring

For personnel wearing semi-permeable or impermeable encapsulating ensembles and/or levels of protection A, B, or C, they should be monitored when the temperature in the work area is above 70°F (21°C). To monitor these workers, the following should be measured:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow the ACGIH Threshold Limit Value recommendations for suggested work and rest schedules listed in Table 3. This work–rest schedule is determined by the Wet Bulb Globe Temperature Index (WBGT), a measure of environmental factors that most nearly correlate with deep body temperature and other physiological responses to heat.

Table 3			
WBGT TEMPERATURE IN WHICH VARIOUS WORK LOADS ARE PERFORMED [F°(C°)]			
WORK-REST REGIMEN	LIGHT²	MODERATE³	HEAVY⁴
Continuous work permitted	86.0 (30.0)	80.1 (26.7)	77.0 (25.0)
75% work 25% rest, each hour	87.1 (30.6)	82.4 (28.0)	78.6 (25.9)
50% work 50% rest, each hour	88.5 (31.4)	84.9 (29.4)	82.2 (27.9)
25% work 75% rest, each hour	90.0 (32.2)	88.0 (31.1)	86.0 (30.0)

1 Adapted from "Permissible Heat Exposure Threshold Limit Values" in Threshold Limit Values and Biological Exposure Indices for 1990-1991, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1990, p. 69.

2 Light work (up to 200 Kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work, etc.

3 Moderate work (200-300 Kcal/hr or 800-1400 Btu/hr): e.g., walking about with moderate lifting and pushing, etc.

4 Heavy work (350-500 Kcal/hr or 1400-2000 Btu/hr): e.g., sampling work, pick and shovel work, etc.

8.2 Prevention

Proper training and preventative measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. One or more of the following recommendations will help reduce heat stress.

- Adjust work schedules
- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
- Add additional personnel to work teams.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

In addition, workers' body fluids should be maintained at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 18 ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful.

- Maintain water temperature at 50° to 60°F (10° to 15.6°C).
- Provide small disposable cups that hold about 4 ounces (0.1 liter).
- Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress, which appear below.

- Heat Rash is caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Symptoms include a decreased ability to tolerate heat as well as being a nuisance.
- Heat Cramps is caused by profuse perspiration with inadequate fluid intake and chemical replacement (especially salts). Signs are muscle spasm and pain in the extremities and abdomen.
- Heat Exhaustion is caused by increased stress on various organs to meet increased demands to cool the body. Signs are: shallow breathing; pale, cool moist skin; profuse sweating; dizziness and lassitude; nausea; fainting.
- Heat Stroke is the most severe form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Body must be cooled immediately to prevent severe injury and/or death. Competent medical help must be obtained immediately. Signs and symptoms are: red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

9.0 EMERGENCY CONTROL, PROCEDURES, AND EQUIPMENT

Emergency contacts and telephone numbers are provided in Table 4. The location of, and directions to, the nearest hospital are shown on the attached figure. ARM, its contractors, and any lower tier subcontractors shall be familiar with these directions prior to the initiation of activities.

9.1 Pertinent Emergency Telephone Numbers

Pertinent emergency telephone numbers are listed below. This information must be reviewed by and provided to all personnel prior to entry to the work area.

Table 4	
Emergency Telephone Numbers	
Facility/Title	Telephone Number
Fire	911
Police	911
Ambulance	911
Hospital – Lewistown Hospital	911

9.2 Procedures for Exposure to Contaminants

The following are procedures for various exposures to contaminants identified in Section 6.0.

9.2.1 Skin Contact

In the event of a personnel exposure to substances listed in Table 2 by skin contact, the following procedures will be employed:

1. Wash skin with copious amounts of soap and water for at least 15 minutes.
2. Transport, if necessary, to the nearest hospital or poison control center.

9.2.2 Inhalation

In the case of inadvertent inhalation of substances listed in Table 2, victims should be:

1. Moved to fresh air immediately.
2. Transported, if necessary, to the nearest hospital.

9.2.3 Ingestion

If ingestion of substances listed in Table 2 occurs, the victim must be transported to the local medical facility for evaluation and treatment.

9.3 Procedures for Accidents

The following are procedures for other accidents that may occur during on-site activities.

9.3.1 Injury

In the event of a personnel injury, emergency first aid would be applied on site as deemed necessary. The field team members should be trained in first aid and be on-site during field operations. The victim should be transported to the local medical facility if needed.

9.3.2 Fire or Explosion

In the event of a fire or explosion, the site will be evacuated immediately and the appropriate emergency response groups notified immediately.

9.3.3 Environmental Incident

In the event of an environmental incident caused by spill or spread of contamination, personnel will attempt to contain the spread of contamination, if possible, and then contact the site manager and/or emergency response agency.

10.0 ACKNOWLEDGEMENT OF PLAN

All site personnel are required to read and comply with the HASP. The following safety compliance affidavit should be signed and dated by each person directed to work on-site.

I have read the HASP for the Mifflin County Planning and Development Department sites, and agree to conduct all on-site work in conformity with the requirements of the HASP. I acknowledge that failure to comply with the designated procedures in the HASP may lead to my removal from the site, and appropriate disciplinary actions by my employer. I certify that I meet the requirements of OSHA 29 CFR 1910.120 for 40-hour safety training and 8-hour annual refresher (*certificates should be supplied and kept on file*).

	Name	Signature	Date
Project Manager ARM Group Inc.			
Site Safety Officer ARM Group Inc.			
Other Site Personnel ARM Group Inc.			
(Subcontractor)			
(Subcontractor)			
(Subcontractor)			

Copyright © 1988-2002 Microsoft Corp. and/or its suppliers. All rights reserved. <http://www.microsoft.com/streets>
© Copyright 2001 by Geographic Data Technology, Inc. All rights reserved. © 2001 Navigation Technologies. All rights reserved.

reserved. This data includes information taken with permission from Canadian authorities © Her Majesty the Queen in Right of Canada.